

Reclamation Safety and Health Standards



**UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION**

1993

**Safety Office
Denver Office
Denver, Colorado**

Bureau of Reclamation Safety Handbook

U.S. Department of the Interior

Mission Statement

As the nation's principle conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Mission

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

TABLE OF CONTENTS

SECTION 1 - AUTHORITY, SCOPE, AND POLICY

SECTION 2 - GENERAL REQUIREMENTS

SECTION 3 - ORIENTATION, TRAINING, WORK .PLANNING

SECTION 4 - MEDICAL FACILITIES

SECTION 5 - RESERVED

SECTION 6 - EMERGENCY PLANS

SECTION 7 - OCCUPATIONAL HEALTH

SECTION 8 - PERSONAL PROTECTIVE EQUIPMENT

SECTION 9 - SIGNS, SIGNALS, AND BARRICADES

SECTION 10 - FIRE PREVENTION AND PROTECTION

SECTION 11 - MATERIAL HANDLING, STORAGE, AND DISPOSAL

SECTION 12 - ELECTRIC WIRING, GROUNDING, AND BONDING

SECTION 13 - WALKING AND WORKING SURFACES

SECTION 14 - O&M (OPERATION AND MAINTENANCE) ACTIVITIES

SECTION 15 - CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

SECTION 16 - HANDTOOLS, POWERTOOLS, PRESSURE VESSELS AND WELDING

SECTION 17 - ROPES, SLINGS, CHAINS, AND ACCESSORIES

SECTION 18 - HOISTING EQUIPMENT, PILEDRIVERS, AND CONVEYORS

SECTION 19 - MOBILE AND STATIONARY MECHANIZED EQUIPMENT

SECTION 20 - RESERVED

SECTION 21 - RESERVED

SECTION 22 - EXCAVATION OPERATIONS

SECTION 23 - TUNNEL AND SHAFT CONSTRUCTION

SECTION 24 - BLASTING OPERATIONS

SECTION 25 - CONCRETE, MASONRY CONSTRUCTION, AND FORMWORK

SECTION 26 - STEEL ERECTION

SECTION 27 - RECLAMATION DRILLING STANDARDS

SECTION 28 - STAGE WORK IN ENERGIZED FACILITIES

SECTION 29 - MARINE AND DIVING OPERATIONS

SECTION 30 - DEMOLITION

APPENDIXES

- A. Eye and face protection
- B. Required shades for filter lenses and glasses
- C. Respiratory and respirable air system selection guide
- D. Scaler's hitch
- E. Control of hazardous energy sources
- F. Hand signals
- G. Signs, signals, and barricades
- H. Fire extinguisher data
- I. Inspection schedule for fire protection equipment
- J. Common flammable and combustible liquids
- K. Single and independent-pole scaffolds
- L. Slings
- M. Trench supporting and/or sloping requirements
- N. Explosives
- O. Fixed ladders
- P. Stairs and ramps
- Q. Single and double cleat job-made ladders
- R. Concrete conveyance systems
- S. Wire rope
- T. Reserved
- U. Record of performance inspection and brake test - crawler, locomotive, truck and wheel cranes
- V. Record of performance inspection and brake test - on-highway type mobile equipment
- W. Record of performance inspection and brake test - off-highway wheel-type construction machines
- AA. Reserved
- BB. Contractor safety program
- CC. Tunnel ventilation design criteria
- DD. Report of injury
- EE. Statistical report
- FF. Sample job hazard analysis
- GG. Glossary of terms and definitions
- HH. Factors for conversion of units
- II. Referenced materials

TABLES

- 1-1 Acronyms and abbreviations
- 7-1 Permissible noise exposures
- 11-1 Maximum allowable size of containers and portable tanks combustible
- 13-1 Minimum nominal size and maximum spacing
- 13-2 Tube and component scaffold minimum dimensions
- 13-3 Figure-four scaffold dimensions
- 13-4 Minimum dimensions for wooden bracket form scaffolds
- 17-1 Maximum allowable chain link wear
- 17-2 Safe working loads for shackles

Appendix A

- 1 Eye and face protection application selection guide

Appendix B

- 1 Selection of shade number for welding filters

Appendix I

- 1 Equipment inspection schedule

Appendix J

- 1 Flammable liquids characteristics

Appendix K

- 1 Minimum nominal size and maximum spacing of members of single-pole scaffolds - light duty
- 2 Minimum nominal size and maximum spacing of members of single-pole scaffolds - medium duty
- 3 Minimum nominal size and maximum spacing of members of single-pole scaffolds - heavy duty
- 4 Minimum nominal size and maximum spacing of members of independent pole scaffolds - light duty
- 5 Minimum nominal size and maximum spacing of members of independent pole scaffolds - medium duty
- 6 Minimum nominal size and maximum spacing of members of independent pole scaffolds - heavy duty
- 7 Ladder-type platform specification
- 8 Tube and coupler scaffolds - light duty
- 9 Tube and coupler scaffolds - medium duty
- 10 Tube and coupler scaffolds - heavy duty

Appendix L

- 1 Maximum allowable wear at any point of link
- 2 Rated capacity (working load limit) for alloy steel chain slings rated capacity (working load limit), pounds
- 3 Rated capacities for single leg slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with fiber core (FC)
- 4 Rated capacities for single leg slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with independent wire rope core (IWRC)
- 5 Rated capacities for single leg slings cable laid rope mechanical splice 7 x 7 x 7 and 7 x 7 x 19 constructions galvanized aircraft grade rope 7 x 6 x 19 IWRC construction improved plow steel grade rope
- 6 Rated capacities for single leg slings 8-part and 6-part braided rope 6 x 7 and 6 x 19 construction improved plow steel grade rope 7 x 7 construction galvanized aircraft grade rope
- 7 Rated capacities for 2-leg and 3-leg bridle slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with fiber core (FC)
- 8 Rated capacities for 2-leg and 3-leg bridle slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with independent wire rope core (IWRC)
- 9 Rated capacities for 2-leg and 3-leg bridle slings cable laid rope mechanical splice only 7 x 7 x 7 and 7 x 7 x 19 constructions galvanized aircraft grade rope 7 x 6 x 19 IWRC construction improved plow steel grade rope
- 10 Rated capacities for 2-leg and 3-leg bridle slings 8-part and 6-part braided rope 6 x 7 and 6 x 19 construction improved plow steel grade rope 7 x 7 construction galvanized aircraft grade rope
- 11 Rated capacities for strand laid grommet - hand tucked improved plow steel grade rope
- 12 Rated capacities for cable laid grommet - hand tucked 7 x 6 x 7 and 7 x 6 x 19 constructions improved plow steel grade rope 7 x 7 x 7 construction galvanized aircraft grade rope
- 13 Rated capacities for strand laid endless slings mechanical joint improved plow steel grade rope
- 14 Rated capacities for cable laid endless slings mechanical joint 7 x 7 x 7 and 7 x 7 x 19 constructions galvanized aircraft grade rope 7 x 6 x 19 IWRC construction improved plow steel grade rope
- 15 Manila rope slings
- 16 Nylon rope slings
- 17 Polyester rope slings
- 18 Polypropylene rope slings
- 19 Synthetic web slings - 1,000 pounds per inch of width single ply
- 20 Synthetic web slings - 1,200 pounds per inch of width single ply
- 21 Synthetic web slings - 1,600 pounds per inch of width single ply

Appendix M, Section C

- 1-1 Timber trench shoring - minimum timber requirements - soil type A $P_a = 25 \times H + 72$ psf (2 ft surcharge)

- 1-2 Timber trench shoring - minimum timber requirements - soil type B $P_a = 45 \times H + 72 \text{ lb/in}^2$ (2 ft surcharge)
- 1-3 Timber trench shoring - minimum timber requirements - soil type C $P_a = 80 \times H + 72 \text{ lb/in}^2$ (2 ft surcharge)
- 2-1 Timber trench shoring - minimum timber requirements - soil type A $P_a = 25 \times H + 72 \text{ lb/in}^2$ (2 ft surcharge)
- 2-2 Timber trench shoring - minimum timber requirements - soil type A $P_a = 45 \times H + 72 \text{ lb/in}^2$ (2 ft surcharge)
- 2-3 Timber trench shoring - minimum timber requirements - soil type A $P_a = 80 \times H + 72 \text{ lb/in}^2$ (2 ft surcharge)

Appendix M, Section D

- 1-1 Aluminum hydraulic shoring - vertical shores - for soil type A
- 1-2 Aluminum hydraulic shoring - vertical shores - for soil type B
- 1-3 Aluminum hydraulic shoring - waler systems - for soil type B
- 1-4 Aluminum hydraulic shoring - waler systems - for soil type C

Appendix N

- 1 Distances for storage of explosives
- 2 Recommended separation distances of ammonium nitrate and blasting agents from explosives or blasting agents

Appendix Q

- 1 Acceptable stress grade lumber for job-made ladders (Note 1)
- 2 Minimum rail size for single-cleat ladders (Nominal dimension lumber)
- 3 Minimum rail size for double-cleat ladders (Nominal dimension lumber)

FIGURES

- 9-1 Danger sign
- 9-2 Caution sign

Appendix A

- 1 Eye and face protection apparatus

Appendix C

- 1 Respirator and respirable air system selection guide C-I
- 2 Respirator and respirable air system selection guide C-II
- 3 Respirator and respirable air system selection guide C-III

Appendix D

- 1 Scaler's hitch

Appendix E

- 1 Warning tags
- 2 Lockout/tagout procedure for electrical source
- 3 Lockout/tagout procedure for hydraulic energy source

Appendix F

- 1 Hand signals for cranes and hoisting equipment
- 2 Helicopter hand signals

Appendix G

- 1 Use of hand signaling devices by flagger
- 2 Channelizing devices and high level warning devices
- 3 Height and lateral locations of signs - typical installation
- 4 Methods of mounting signs other than on posts
- 5 Typical application - daytime maintenance operations of short duration on a 2-lane roadway and flagging is provided
- 6 Typical applications of traffic control devices on 2-lane highway where one lane is closed and flagging is provided
- 7 Typical applications of traffic control devices on a 2-lane highway where the entire roadway is closed and a bypass detour is provided
- 8 Typical application - 4-lane undivided roadway, where half the roadway is closed
- 9 Typical application - daytime maintenance operations of short duration on a 4-lane divided roadway where half of roadway is closed

Appendix H

- 1 Fire extinguisher data

Appendix K

- 1 Single-pole wood-pole scaffold design
- 2 Independent wood-pole scaffold design
- 3 Outrigger scaffold design
- 4 Figure-four form scaffold design
- 5 Metal bracket form scaffold design
- 6 Wooden bracket form scaffold design

Appendix M

- 1 Aluminum hydraulic shores
- 2 Pneumatic/hydraulic shoring
- 3 Trench jacks (screw jacks)
- 4 Trench shields

Appendix P

- 1 Graphic analysis
- 2 Table of proportions

Appendix Q

- 1 Example of permissible knot spacing
- 2 Slope of wood grain
- 3 Cleat attachment, single cleat ladders
- 4 Cleat attachment, double cleat ladders
- 5 Ladder pitch
- 6 Methods for securing base
- 7 Clearance for climbing side and backside of ladder
- 8 Deflector plates for head hazards
- 9 Clearance for unavoidable obstruction at rear of ladder

Appendix R

- 1 Crane boom mounted concrete conveyor system
- 2 Crane boom mounted concrete conveyor system example of load testing procedures
- 3 Safety tremie
- 4 Pipe couplings
- 5 Pumping line cleanout operations (suction method)
- 6 Pumping line cleanout operations (water pressure method)
- 7 Pumping line cleanout operations (compressed air method)
- 8 Truck mounted concrete pumps and placing booms
- 9 Stationary mounted placement booms

Section 1

AUTHORITY, PURPOSE, AND SCOPE

1.1 **AUTHORITY.** Authority to expend funds and manpower to develop and implement programs that protect the safety and health of Federal and contractor employees and prevent accidental damage of Government property is detailed and required by Federal law and departmental regulations. (See 5 U.S.C. 7902; Sections 6 and 19 of Public Law 91-596, Occupational Safety and Health Act of 1970; 29 U.S.C. 651 et. seq., 43 U.S.C. 1457, Executive Order 12196, 29 CFR 1960; Contract Work Hours and Safety Standards Act; Departmental Manual, 485 DM; and Reclamation Instructions Part 365.

1.2 **PURPOSE.** This manual prescribes the safety and health requirements for all Bureau of Reclamation (Reclamation) activities and operations.

1.3 **SCOPE.** This manual applies to all Reclamation activities (Administration, Operation and Maintenance, Construction, Hazardous Waste Site Work, Service Contracts, Suppliers, Contracts with Water Districts, Loan Programs, Recreation Administration, etc.) whether accomplished by Reclamation or contractor personnel. Provisions for compliance with these standards shall be incorporated in Reclamation Instructions, Regional Office supplements thereto, and all contracts requiring onsite performance of construction, investigation, alteration or repair work. These standards are consistent with the health and safety standards prevalent in industry and those promulgated under the Occupational Safety and Health Act of 1970, Public Law 91-596.

1.4 **DEFINITIONS.** When appearing in the text of this manual, the words "office head" means the Reclamation official responsible for the area or work activity to which the standard applies, unless otherwise indicated. The words "shall" and "will" are to be interpreted as mandatory, while "should" or "may" are advisory. Terms such as "approved," "authorized persons," "competent person," "licensed professional engineer," "contaminant," "defect," "hazardous," "qualified," "safety factor," etc., appear throughout the text of this manual. Such terms shall be interpreted and convey the meaning as specifically defined in the various subparts of Title 29 CFR Part 1910, "Occupational Safety and Health Standards," and Part 1926, "Safety and Health Regulations for Construction," and the Glossary of Terms and Definitions contained in Appendix GG.

1.5 **METRIC EQUIVALENTS.** Metric conversion factors for U.S. customary (inch-pound) dimensions are provided in Appendix HH.

1.6 **ACRONYMS AND ABBREVIATIONS.** Table 1-1 lists most of the definitions of acronyms and/or abbreviations used in this manual.

Table 1-1. - Acronyms and abbreviations.

ACI	American Concrete Institute
ACGIH	American Conference of Governmental Industrial Hygienists
AGCA	Associated General Contractors of America
API	American Petroleum Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
CFR	Code of Federal Regulations
CO	Contracting Officer
COR	Contracting Officer's Representative
DOT	Department of Transportation
EMT	Emergency Medical Technician
FAA	Federal Aviation Administration
FHA	Federal Highway Administration
FOPS	Falling Object Protection Structure
JHA	Job Hazard Analysis
LPG or LP-gas	Liquefied Petroleum Gas
LPN	Licensed Practical Nurse
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NEC	National Electrical Code
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PCSA	Power Crane and Shovel Administration
PEL	Permissible Exposure Limit
PFD	Personal Flotation Device
POL	Petroleum, Oils, and Lubricants
RN	Registered Nurse
ROPS	Rollover Protective Structures
SAE	Society of Automotive Engineers
UL	Underwriters Laboratories

Section 2

GENERAL REQUIREMENTS

2.1 **RESPONSIBILITY.** The responsibility for program accomplishment is as follows for Reclamation and contractor activities.

a. **Reclamation.** It is the responsibility of line managers and supervisors or staff managers and supervisors when acting in the capacity of line managers to provide employees a safe and healthful work environment including, but not limited to, implementation and enforcement of all program elements and provisions of this manual. It is the responsibility of each employee to observe all safety and health regulations and comply with instructions issued to them by their supervisors. Employees shall promptly correct unsafe working conditions or report them to their supervisor or other proper authority. All submittals required by this manual for Reclamation operations shall be directed to the appropriate office head.

b. **Contractor.** The contractor is responsible for ensuring that all onsite and offsite activities, equipment, and facilities - whether performed, operated, maintained, or constructed by the contractor, subcontractor, or supplier - conform fully with the standards contained and referenced herein. Offsite activities, equipment, and facilities covered by these standards are only those which are for the exclusive support of the contract work. Further, the contractor, subcontractor, and suppliers shall not require or permit any employee employed in the performance of the contract to engage in work under conditions which are unsanitary, hazardous, or dangerous to an employee's health or safety, whether or not such conditions are addressed herein or in referenced codes, standards, or statutes. Contractors shall include provisions for compliance with the health and safety requirements of this manual in the terms and conditions of all contracts, subcontracts, and supply contracts for onsite and applicable offsite work. All submittals required of the contractor by this manual shall be directed to the CO (Contracting Officer) or the COR (Contractor Officers Representative) as appropriate.

c. **Emergency operations.** Emergency conditions do not relieve the employer of the responsibility for providing a safe and healthful workplace for employees, or for complying with these standards.

2.2 **OTHER CODES AND STATUTES.** In addition to the standards and requirements set forth herein, Reclamation and contractors shall comply with applicable provisions of Federal, State, and municipal safety, health, and sanitary statutes and codes. In event there is a conflict between the provisions of this manual and the safety and health regulations promulgated by the U.S. Department of Labor in Title 29 CFR Parts 1910 and 1926, Occupational Safety and Health Act of 1970, or approved State plans, the more stringent provision shall prevail.

2.3 WAIVERS AND VARIANCES. In circumstances where literal application of a provision of this manual has impractical aspects, the appropriate office head or the CO may waive or authorize a variation to the provision. All requests for a waiver or variance shall be initiated, in writing, directed to the appropriate office head or the COR. The written request shall include: (a) a reference to the specific provision of the standard, (b) an explanation as to why the provision is considered impractical, and (c) the proposed adaptation to the standard. The request shall contain pertinent technical data, drawings, material or equipment specifications, and other information which will enable the office head or the CO to render a decision. In each instance, however, no waiver or adaptation will be approved which endangers the health and safety of any person, is not consistent with the intent of the provisions of this manual, or would constitute a variance to Federal or State regulations. Reclamation or the contractor shall not proceed to waive or revise the provision until the Reclamation office head or the CO's written approval is received.

2.4 DIFFERING OPINIONS. Differing opinions between the contractor and Reclamation on adequacy of existing or proposed protective measures, equipment, procedures, or devices shall be resolved as follows:

- a. The contractor shall not start or continue using the measure, procedure, equipment or devices, or expose employees to associated hazards until the differences have been resolved.
- b. Upon resolution of the differing opinions, either with or without an independent professional engineer's input, the questionable measure, procedure, equipment, or device shall be brought into conformance with the agreed-upon solution. Only personnel required to complete remedial work shall be exposed to the associated hazard, and then only in a manner acceptable to the COR or office head.
- c. Obtaining engineering data or retaining the services of an independent professional engineer to assist in resolving the issue(s) remains a contractor responsibility.

2.5 CERTIFICATION. Design of major or critical facilities, equipment, support structures, or systems, embankments, shoring systems, formwork (falsework) shall be certified as structurally suitable for the use intended. This certification shall be made in writing by the manufacturer or a registered professional engineer competent in these fields and shall be submitted to the COR or office head prior to erection or use of such facilities, equipment, or support systems. (Refer to secs. 18, 19, 22, 25, and contract specifications for additional requirements.)

2.6 SUBMITTALS. Where submittal or acceptance is required by these standards, contractors shall direct submittals to the COR. Reclamation officials will direct submittals to the office head or his/her delegate.

2.7 SAFETY PROGRAMS.

2.7.1 Reclamation accident prevention plans. Reclamation office heads shall prepare an APP (accident prevention plan) for major or complex projects or work activities having high

hazard potential. JHAs (Job Hazard Analyses) shall be prepared for less complex work activities. (See subsec. 3.5 and app. FF.)

2.7.2 Contractor safety programs. The prime contractor shall prepare a comprehensive written safety program covering all aspects of onsite and applicable offsite operations and activities associated with contract. (See app. BB.) Unless adequately covered in the original plan, a supplementary detailed plan will be submitted prior to start of each major phase of work or when requested by the COR. In no case will onsite work commence until the program or appropriate supplementary submittals have been accepted by the COR. Initial and supplementary submittals shall include a timetable for completing required, detailed, JHAs. (See app. FF and subsec. 3.5.) Acceptance of contractor initial and supplementary programs only signifies that the submittals generally conform to the requirements contained and referenced herein. It does not relieve the contractor of the responsibility for providing employees with a safe and healthful work environment or complying fully with all aforementioned requirements and applicable specification paragraphs.

2.8 CONTRACTOR PRECONSTRUCTION SAFETY MEETING. Representatives of the contractor shall meet with the COR and the COR's staff prior to the start of construction for the purpose of reviewing the respective safety requirements and discussing implementation of all health and safety provisions pertinent to the work under contract. Contractors shall be prepared to discuss, in detail, the procedures they intend to use to control the hazards incident to the major phases of the work under contract and to comply with contractual obligations. This meeting will be devoted to discussing the manner in which the contractor intends to administer their health and safety program and delegate the responsibilities for implementing the program.

2.9 CONTRACTOR SAFETY PROGRAM REVIEW. Following the preconstruction safety meeting and development of the safety program, a second meeting shall be held for the purpose of reviewing the contractor's written safety program. The contractor's principal onsite representative, the general superintendent, and his safety representative shall attend this meeting.

2.10 JOINT SAFETY POLICY MEETING. The COR, the contractor's principal onsite representative, and designated members of their respective staffs shall participate in scheduled monthly safety meetings. These meetings shall be used to review the effectiveness of the contractor's safety effort, to resolve health and safety problems relating to current operations, and to provide a forum for planning safe future construction activities. Meeting minutes shall be prepared by the contractor and maintained in a manner prescribed by the COR.

2.11 SAFETY PERSONNEL. When the contract does not require the services of a full-time safety engineer, the contractor shall designate in writing a competent and dependable supervisory employee, acceptable to the COR, to administer his safety program. However, should the contractor's safety effort be considered inadequate, the CO has the option to require the contractor to employ a full-time qualified safety engineer in lieu of a safety representative. Further provisions are made in these standards for the use of environmental health and safety specialists where special or technical expertise is required.

2.12 SAFETY INSPECTION. The contractor shall provide for frequent and regular (at a minimum once a week) safety inspections of the worksites, materials, and equipment by competent employees. Detailed written inspection records shall be maintained and available for review by the COR.

2.13 ACCIDENT/INJURY/ILLNESS INVESTIGATION AND REPORTING

2.13.1 Definitions:

a. *Serious accidents/incidents.* Any occurrence of job-related nature including suicide or homicide attempts, heart attacks, and occupational diseases which result in:

1. A Government, contractor, subcontractor, or supplier employee suffering death, permanent total disability, complete and/or permanent loss of an eye, hand, foot, or major organ.
2. Hospitalization of five or more Government and/or contractor, subcontractor, or supplier employees, or one or more employees in critical condition.
3. Fires or property damage resulting in a loss of \$100,000 or more.
4. Third party injuries, death, or substantial property losses that result or could result in claims against the Government.

b. *Nonserious accident/incidents.* All other personal and/or property damage accident/incidents except first aid cases and property damage losses less than \$2,500.

c. *Potentially serious accident/incidents.* Near-miss accidental occurrences with serious potential such as major equipment failures, contact with high voltage lines, spills, or personal contacts with excessive amounts of toxic or hazardous materials, slides, cave-ins, etc.

2.13.2 Investigation/reporting.

a. Contractor

1. Serious accident/incidents shall be reported immediately to the COR and appropriate contractor personnel. Providing and obtaining appropriate medical and emergency assistance and notification of coroner, law enforcement agencies, and family members remain a contractor responsibility. Except for rescue and emergency measures, the scene of the accident/incident shall not be disturbed or the operation resumed until authorized by COR. The contractor shall assist and cooperate fully with the COR in conducting the investigations of the accident/incident and ensure availability of all information, personnel, and data pertinent to the investigation. The contractor shall, when ordered by the COR, conduct or have conducted a separate and

complete independent investigation of the accident/incident, and submit a comprehensive report of findings and recommendations to the COR. The contractor shall arrange and be financially responsible for the independent investigation and any equipment or material inspections or tests, or diagnostic studies required by the Government or contractor investigators. Further, Reclamation form 7-2077, "Contractor's Report of Recordable Injury/Illness," (app. DD) shall be completed and submitted to the COR for each injured person.

2. Nonserious accident/incidents will be reported immediately to the contractor's supervisor delegated authority to arrange for medical assistance and/or investigate the accident/incidents. Following arrangement for required medical assistance, the responsible supervisor will investigate the accident/incident. Within 3 working days following the accident, the contractor will submit to the COR a completed Reclamation form 7-2077, "Contractor's Report of Recordable Injury/Illness", (app. DD) for all personal injuries, and a comprehensive narrative report for property damage accidents.

3. Potentially serious accident/incidents shall be reported immediately to the COR. The contractor's involved equipment and/or worksite shall remain secured until the contractor has completed a COR-acceptable comprehensive investigation and the COR has given permission to resume work. Within 5 days following the investigation, a detailed written investigation report will be submitted to the COR.

2.14 MONTHLY ACCIDENT SUMMARY REPORT. The contractor shall submit by the first day of each month a completed Reclamation reporting form 7-2218, entitled "Contractor Recordable Accident Experience," (app. EE) or equivalent form acceptable to the COR. Statistical cutoff dates can coincide with appropriate pay periods as long as the ending date of the current report is the beginning date of the following report.

2.15 HOUSEKEEPING. Good housekeeping, including provision and facilities for routine scrap removal, shall be maintained in all areas within the contractor's scope of operation and throughout Reclamation facilities.

2.16 ENVIRONMENTAL POLLUTION Handling, storage, use, and disposal of toxic materials of any nature shall be carried out in a manner so as not to contaminate or pollute water supplies, rivers, lakes, reservoirs, streams, or the atmosphere. Disposal of all such materials, including waste, garbage, and sewage, shall comply with Federal, State, and local regulations.

2.17 PROHIBITED USE OF ALCOHOL, DRUGS AND FIREARMS. Intoxicating beverages and narcotics use on Government property shall not be permitted. Persons under the influence of alcohol or narcotics shall not be permitted on the jobsite. Contractors shall comply with specification requirements for employee drug-free workplace programs. Reclamation or contractor employees using prescribed medication(s) shall contact their physician to ensure that their performance will not be impaired. Firearms shall not be permitted on construction sites or Reclamation property without prior approval of the COR or the office head.

2.18 PHYSICAL QUALIFICATIONS. Persons employed throughout the course of the work shall be physically qualified to perform their assigned duties in a safe manner. Employees shall not be permitted or required to work while their ability or alertness is impaired because of drugs, fatigue, illness, intoxication, or other conditions that may expose either themselves or others to injury.

2.19 PUBLIC SAFETY. The public should be restricted from work areas to the extent possible. In areas where significant public interest exists, safe areas from which the public may view the work will be provided.

Section 3

INDOCTRINATION, TRAINING, WORK PLANNING

3.1 ORIENTATION

3.1.1 **Reclamation.** Every new Reclamation employee shall receive orientation on provisions of the safety and health program. The orientation shall include applicable requirements of RI Part 365, safety and health policies, reporting of accidents and injuries, first aid and medical care, applicable safety and health standards, and sources of information on safety and health questions.

3.1.2 **Contractor.** Every new contractor employee shall be issued a written notice containing pertinent provisions of the safety and health program. The notice shall indicate general policy and set forth procedures and regulations applicable to the work environment, reporting of injuries, and first aid and medical care. Each employee shall acknowledge receipt of these instructions. Acknowledgement shall be filed by the contractor and shall be available for review.

3.2 ONSITE TRAINING

3.2.1 **General.** Employees exposed to hazards associated with specific work assignments, i.e., underwater diving, entering confined spaces, working on or adjacent to high-voltage lines or equipment, firefighting, or blasting, shall be thoroughly acquainted with respective hazards and instructed in the pertinent provisions of this manual relating to such exposures. The employer is responsible for such instructions together with ensuring that (1) employees possess the necessary qualifications, licenses, and/or permits required to perform such work, and (2) JHAs conforming to subsection 3.5 have been developed and discussed with affected employees.

3.2.2 **First aid/CPR training.**

a. *Contractor.* Every contractor foreman shall possess a current first aid/CPR certificate from a recognized provider.

b. *Reclamation.* Specific requirements for first aid/CPR training for Reclamation employees are contained in RI Part 365.3.4 and .5.

c. All first aid/CPR training shall contain coverage on means of recognition and avoidance of bloodborne pathogen exposure.

3.2.3 **Contractor Supervisor Training.** All contractor onsite supervisors including foremen shall, within 30 days following start of construction and annually thereafter, attend a 4-hour

classroom review of applicable safety and health requirements. Supervisors and foremen employed between formal training sessions will receive the initial 4 hours of instructions from the contractor's safety representative and attend all subsequent annual reviews. This manual and the contractor's safety program shall be used as a text for all training sessions. Records detailing course content and names of attendees shall be maintained by the contractor and available for review by the COR. A Reclamation representative will be available for the formal classroom reviews to assist in the interpretation of safety standards. The COR may grant exceptions to supervisory training requirements for short-term contracts or other discretionary reasons.

3.3 CONTRACTOR SAFETY MEETINGS

3.3.1 **Supervisors.** The contractor shall conduct regularly scheduled supervisory safety meetings at least monthly for all levels of job supervision. An outline report containing subject matter and signatures of all attendees shall be maintained by the contractor and available for review.

3.3.2 **Employees.** A minimum of one "on-the-job" or "toolbox" safety meeting shall be conducted weekly by each field supervisor or foreman and shall be attended by all employees under their supervision. A record of each meeting, including signatures of attendees, shall be maintained and available for review.

3.4 RECLAMATION SAFETY MEETINGS

3.4.1 **Safety Meetings.** Reclamation employee safety meetings shall be held in accordance with RI 365.2.4.

3.5 JOB HAZARD ANALYSIS (JHA) (Appendix FF)

3.5.1 **Requirement.** The responsible supervisor or foreman, in consultation with employees who will do the work and a safety or health representative if needed, shall conduct a JHA of each existing activity and for new activities before their implementation. JHAs will be developed and discussed with affected employees prior to engaging in activities (1) involving or generating hazardous or toxic materials, and (2) associated with confined spaces or hazardous work, i.e., high scaling, suspended work platforms, blasting, high-voltage electrical, drilling, and underwater activities. JHAs governing work associated with toxic and/or hazardous materials will include reference to required material safety data sheets or, if data sheets are not required, equivalent information from CFR 29 Part 1910, Subpart Z, "Toxic and Hazardous Substances," and/or other occupational health publications.

3.5.2 **Written procedure.** Written procedures for selected operations shall prescribe the manner in which actions are to be accomplished, the proper sequence, equipment required, specific instructions or limitations, potential hazards and preventive measures, and instructions. Written procedures shall also reference appropriate codes, standards, and regulations. The total integration of these factors into a written procedure assists the responsible supervisor to provide

adequate on-the-job instructions to employees before the start of work and also basic information for tool-box meetings. Such instructions and training are the most important methods of eliminating omissions or unwanted actions that cause unplanned occurrences resulting in injuries and operational errors. They also reflect the attitude of management toward accident prevention and assist supervisors in carrying out their responsibilities relating to safe and efficient operations.

3.5.3 Basic Elements of JHA. Developed written procedures shall be recorded in narrative form or on a standard printed form. (See example in app. FF.)

As a minimum, the following basic elements must be included:

- a. *Title:* Identifies project and specifies operation.
- b. *Number:* Used for recording and indexing.
- c. *Date:* Required to ensure procedure is current. Annual or biennial revision dates with reviewer's initials shall be included.
- d. *Introduction or general instructions:* A clear statement of function, purpose, and objective, complete with correlation of authority and responsibility that must be met before starting operation. Plant or project situations requiring description and other items of special interest shall be included.
- e. *Equipment, tools, and all facilities involved.*
- f. *Principal steps of operation in sequence:* Operations should only be broken down into sequence of significant steps necessary to ensure adequate consideration of important items.
- g. *Special instructions or limitations.*
- h. *References:* Reference to codes, standards, or regulations are optional and depend on need to identify limitation sources or additional requirements for training purposes.
- i. *Safety equipment and apparel:* In addition to noting this equipment in the operational breakdown, it is helpful to list the equipment in a separate location for quick review before leaving the office or shops.
- j. *Signatures of the supervisor or foreman and the employee(s) assisting in development of procedure:* These signatures provide others using the procedure with a source for obtaining additional information or clarification and give employees credit for their contribution.
- k. *Signature of higher-level supervisor:* Each procedure shall be reviewed and approved by a knowledgeable higher-level manager before implementation.

Section 4

MEDICAL FACILITIES

4.1 GENERAL

4.1.1 **Requirement.** Prior to start of operations, arrangements shall be made for prompt medical attention for injured or disabled employees in conformance with this section. Such arrangements shall provide for dependable ambulance service and services of a consulting physician for consultation on matters of emergency treatment and occupational health.

4.1.2 **Communication.** Adequate and reliable means of communication shall be provided from the jobsite to the nearest offsite medical facility. All employees shall be provided a positive means for obtaining assistance in emergency situations.

4.1.3 **Signs.** Identification and directional markers shall be provided to clearly indicate the location of first aid and medical facilities.

4.1.4 **Emergency lighting.** Emergency lighting shall be provided in onsite first aid and medical facilities.

4.2 FIRST AID AND MEDICAL FACILITIES

4.2.1 **Minimum requirement.** Unless otherwise specified, the following are minimum requirements for the establishment of onsite first aid and medical facilities:

a. **Class A - First Aid Services.**

1. On projects or jobs where less than 100 workers are employed (total number of employees on largest shift) and where neither a first aid station or medical facility is available, first aid supplies will be provided and easily accessible. The supplies and their locations shall be approved by the consulting physician, but in no case will there be less than one 16-unit first aid kit for each 25 or fewer employees. The first aid kit shall consist of a weatherproof container with individually sealed packages for each type of item. First aid kit contents will be checked prior to issuance and weekly thereafter and expended items replaced. Records of inspections will be maintained with each kit.

2. At least one employee qualified to administer emergency first aid/CPR shall be available on each shift and duly designated by the employer to care for injured employees. Crews working in isolated locations shall have at least one employee qualified to administer emergency first aid/CPR with the crews.

3. At least one stretcher, two blankets, and a 16-unit first aid kit shall be readily available to persons designated to administer first aid/CPR.

4. A first aid kit shall be provided when one or more employees are working in locations not readily accessible to a first aid or other type medical facility.

b. Class B--First Aid Station.

1. On projects or jobs where more than 99 but less than 300 persons are employed or will be employed (total number of employees on the largest shift), a first aid station shall be established and equipped as directed by the consulting physician.

2. At least one employee qualified to administer emergency first aid/CPR shall be available on each shift and duly designated by the employer to care for injured employees. Crews working in isolated locations shall have at least one employee qualified to administer emergency first aid/CPR with the crews.

3. An RN (Registered Nurse) with emergency room experience, an EMT (Emergency Medical Technician), or a paramedic shall be on duty in the station when work is in progress except when on emergency call. The RN or EMT shall be approved by and under the general direction of the consulting physician. In no case will the physician's approvals or recommendations be less stringent than those contained in this standard or specification requirements.

4.3 AMBULANCE

4.3.1 Requirement. As required by the provisions of this section, dependable ambulance service for the transportation of sick or injured shall either be provided or arrangements made for the service.

4.3.2 Ambulance Service. Acceptable ambulance service may be either: (a) reliable ambulance service provided by a firm or individual licensed or certified by a State regulatory agency as qualified to render such service, (b) a standby emergency vehicle, maintained in operable condition, at the jobsite, or (c) air ambulance. All such vehicles shall be inspected and approved for the intended use by the employer's consulting physician. The consulting physician shall designate or approve specific equipment to be maintained in the ambulance or aircraft for the emergency care of the sick or injured.

4.3.3 Operators. Operators of ambulances shall be certified by the consulting physician, or State regulatory agency, as qualified to render first aid/CPR and to operate the vehicle in a competent manner. They shall be immediately available for operation of the vehicle during all hours that work is in progress.

4.4 **FIRST AID AND MEDICAL RECORDS**

4.4.1 **Requirement.** Reclamation employee records shall be kept in accordance with RI Part 365.4.3. Contractors shall maintain current first aid/CPR treatment and medical records. Such records shall include:

- a. A daily treatment log
- b. Cumulative individual injury records
- c. Monthly statistical records of occupational injuries classified as to type and nature of injury
- d. Required workmen's compensation records

4.4.2 **Review.** All records referred to in paragraph 4.4.1 shall be available for review.

Section 5

RESERVED

Section 6

EMERGENCY PLANS

6.1 **GENERAL.** Emergency plans to ensure employee safety in the event of fire, cave-ins, floods, or other emergencies shall be prepared in writing and reviewed with all affected employees. Emergency plans shall be tested to ensure their effectiveness.

6.2 **PLANS.** Plans shall include lines of authority for emergency procedures; training requirements for all assisting in the emergency evacuation of personnel, as well as communicating the plan to affected personnel; require emergency equipment; escape procedures and routes; critical facility operations; employee accounting following an emergency evacuation; rescue and medical duties, means of reporting emergencies; and persons to be contacted for information or clarification.

6.3 **ALERT SYSTEMS.** Emergency alert systems shall be developed and tested to alert all persons likely to be affected by existing or imminent disaster conditions and to alert and summon the people and equipment comprising the emergency response capability.

6.4 **COMMUNICATIONS.** Emergency telephone numbers and reporting instructions for ambulance, medical services, hospital, fire, and police shall be conspicuously posted. Telephone lines and radio frequencies shall be kept clear for the use of those in charge during an emergency.

6.5 **SAFETY.** The safety of employees, the public, or property shall not be jeopardized due to the urgency to resume operations or to restore service.

Section 7

OCCUPATIONAL HEALTH

7.1 GENERAL REQUIREMENTS. This section outlines the general requirements for compliance with occupational health regulations. Reclamation operations are covered in detail in the *Reclamation Occupational Health Handbook*. Contractor- detailed requirements are found in codes and regulations referenced elsewhere in this manual.

7.1.1 Key Requirements. Exposure determinations are required to assess employee exposure to hazardous materials or physical agents from all routes of exposure--skin, ingestion, and inhalation. Written management and/or control programs are required when there is exposure or an exposure risk present in the workplace.

Exposure is defined as worker exposure equal to or exceeding the PEL/TLV; and exposure risk as worker exposure equal to or exceeding the action level.

Engineering controls must be given priority in every exposure situation requiring control.

7.1.2 JHA (Job Hazard Analysis). A written JHA including exposure determinations is required when the following hazardous work situations exist:

- Exposure to hazardous materials or physical agents
- Respirator use
- Hearing protection devices use
- Confined space work or entry
- Radiation sources
- Biological hazards, and/or physical safety hazards exist.

7.1.3 Industrial hygienist. Where operations involve exposure or exposure risk (as defined above in para. 7.1.1) to hazardous materials or physical agents, the employer shall provide for the services of a qualified industrial hygienist to formulate a control program and periodically check its effectiveness. The control program must be developed during initial phases of the work.

7.1.4 Recordkeeping. Employee medical, exposure monitoring, and training records shall be maintained and available for review.

7.1.5 Employees working in a hazardous workplace shall receive training in the nature of the hazard, exposure levels, and the control requirements.

7.2 EXPOSURE LIMITS

7.2.1 **PEL/TLV.** The employer shall comply with the more stringent requirement of OSHA PELs, ACGIH TLVs, or more stringent State or local standards or the industrial hygienist responsible for the work.

7.2.2 **Inhalation hazard.** Control programs are required when airborne contaminants equal or exceed the action levels established in specific occupational health standards. In the absence of specific action levels, Reclamation has adopted 50 percent of the appropriate PEL/TLV as the action level. Engineering controls are required when worker exposures equal or exceed the PEL/TLV.

7.3 EXPOSURE MONITORING

7.3.1 **Key Requirements.** Based on exposure determinations and/or the JHA, exposure monitoring shall be conducted when hazardous materials or physical agents are present in the workplace that generate exposure risk to employees, contractors, or visitors. Exposure monitoring is required when employees wear respiratory protection. Employee exposure monitoring shall be conducted under the direction of an industrial hygienist.

7.4 BIOLOGICAL MONITORING

7.4.1 **Key Requirements.** Biological monitoring shall be conducted when found necessary by the consulting physician and/or industrial hygienist. The monitoring shall be used to determine compliance with established ACGIH biological exposure indices (BEIs), as part of a medical surveillance program, when it is deemed necessary to (1) substantiate air monitoring, (2) test the efficacy of personal protective equipment, (3) determine the potential for absorption via skin and the gastrointestinal system, or (4) detect non-occupational exposure.

7.5 MEDICAL SURVEILLANCE

7.5.1 **Key requirements.** A written employee medical surveillance program shall be established when employees are exposed or are at risk of exposure as determined by credible exposure monitoring, exposure determination, and/or by regulation. This program must be specific to meet the requirements of the JHA and the exposure monitoring results.

7.5.2 **Medical surveillance.** When medical surveillance is required by an exposure determination or by regulation, it shall be conducted by a physician specializing in occupational medicine. The examining physician must be provided a description of duties as relates to the hazardous workplace, results of employee exposure monitoring, a description of personal protective equipment used, and information from previous medical examinations.

7.6 HAZARD COMMUNICATION

7.6.1 **Key requirements.** Programs shall be administered to effectively manage and communicate hazards of chemicals used, stored, or produced in the workplaces to all potentially exposed employees, contractors, visitors, and the public.

7.6.2 **Hazard determination.** When hazardous chemicals are used, an exposure determination shall be made to assess exposures and to document that the exposures are within acceptable limits.

7.6.3 **Employee training.** Employees shall be provided complete information on hazardous work. Training in safe workplace practices is required. Training must include the provisions of the Hazard Communication Standard, hazardous chemical usage that impacts work areas, the location and availability of the specific written HCP (hazard communication program), hazardous chemical list, and MSDS (material safety data sheets) file, physical and health hazards, environmental and medical monitoring requirements, protective measures for safe work, and any special or specific components of the HCP. Training shall be documented.

7.6.4 **Written hazard communication plan.** When hazardous chemicals are used, produced, or stored in the workplace, a written HCP that details and describes the method of safe practice and standard compliance shall be developed. The written program shall be approved and maintained on file. This written program will be made available to all participating employees and program evaluation officials.

7.6.5 **Hazardous chemical inventory.** A listing of hazardous chemicals is required for each workplace where hazardous chemicals are produced, stored, or used.

7.6.6 **MSDS file.** MSDSs shall be obtained for all hazardous chemicals used in the workplace and must be readily available to workers using chemicals and those conducting evaluations and inspections.

7.6.7 **Warnings and labels.** The entrance to each workplace shall be posted with warning signs if a risk of exposure at or above the action level exists.

7.7 NOISE EXPOSURE AND HEARING CONSERVATION

7.7.1 **General.** Employees and the public shall be protected from the effects of harmful noise exposure. Such responsibility shall include provision for determining the presence of harmful noise levels and exposures with the implementation of an effective noise control plan when noise exposures exceed the values set forth herein.

Table 7-1. - Permissible noise exposures

Duration per day, hours	Sound level, dBA, slow response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115
0	115

Exposure to continuous or intermittent noise levels in excess of 115 dBA are not permitted.

Noise effecting offsite areas such as residences, businesses, or other occupancies shall be limited to restrictions set by local authorities.

7.7.2 Noise control requirements. Protection against the effects of noise shall be required when the noise exposure reaches 85 dBA. Hearing protection with appropriate employee training is required of all employees exposed to 85 dBA regardless of exposure time.

7.7.3 Noise monitoring. Monitoring of sound pressure levels must be performed with a calibrated sound level meter when noise levels are above 80 dBA. Personal noise dosimetry is required when employees work in noise areas at or above 90 dBA for any period of time. Annual noise dosimetry is required for all employees receiving annual audiometric testing.

Dosimeter readings that equal or exceed 85 dBA TWA require followup evaluation to identify the cause of noise exposure, to document the existing controls, and to make further recommendations to management.

7.7.4 Hearing conservation. A written hearing conservation program is required when noise surveys and/or personal dosimetry characterize employee noise exposures of 85 dBA TWA or greater.

- a. Annual audiometric testing is required for all employees whose exposure equals or exceeds 85 dBA TWA. When exposures exceed 100 dBA TWA, testing is required at 6-month intervals for a minimum of 2 years.

When the audiogram detects a temporary threshold shift indicative of a standard or significant threshold shift or of a progressive noise-induced hearing loss, this hearing loss must be confirmed by additional audiometric testing. Employees must receive notification of audiometric test results within 21 calendar days of test. A confirmed threshold shift is a reportable occupational illness.

7.7.5 Hearing protection. Hearing protection provided employees must attenuate employee's effective sound level exposure to less than 85 dBA. The manufacturer's NRR (noise reduction rating) for hearing protectors is reduced by 50 percent in determining the exposure level.

7.7.6 Warnings and labels. At the entrance to each work area that exposes individuals to 85 dBA, a "**CAUTION - NOISE AREA, HEARING PROTECTION REQUIRED**" sign shall be posted. Work areas that exceed 100 dBA must be posted with a "**DANGER - NOISE AREA, AUTHORIZED PERSONNEL ONLY**" sign at each entrance.

7.8 CONFINED SPACE

7.8.1 Key Requirements. Every enclosed space shall be evaluated and classified as a confined space if it has one or more of the following:

- a. Is large enough and so configured that an employee can bodily enter and perform assigned work.
- b. Has limited or restricted means for entry or exit (i.e., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- c. Is not designed for continuous employee occupancy.

7.8.2 List of confined spaces. The employer must compile a complete list of all confined spaces and determine whether the space is a permit space or nonpermit space.

7.8.3 Permit-required confined space. A confined space shall be classified as a permit-required confined space (permit space) if it has one or more of the following characteristics:

- a. Contains or has the potential to contain a hazardous atmosphere.
- b. Contains a material that has the potential for engulfing an entrant.
- c. Has an internal configuration such that the entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section.

d. Contains any other recognized serious safety or health hazard.

7.8.4 Permit space entry requirements. Before employees enter or perform work in a permit-required confined space, the employer must have in place a current written program. This program must detail testing and air monitoring provisions, employee training, control methods, permit system, designation of persons authorized to permit entry, identify authorized entrants, attendants, and air monitors.

7.8.5 Warnings and signs. A hazard warning sign restricting unauthorized employees must be posted at the entrance to each permit space, for example, "**DANGER - PERMIT REQUIRED CONFINED SPACE - AUTHORIZED ENTRANTS ONLY**".

7.8.6 Entry control. The entry permit system must provide for periodic review for changing conditions in the space and control for confined space activities. It must outline entry procedure revision.

7.8.7 Employee training. Employers must ensure that authorized entrants, attendants, authorizing personnel, and rescue team members have received training specific to their assigned space entry duties.

7.9 HAZARDOUS WASTE

7.9.1 Key requirement. Programs shall be developed and implemented to protect employees, contractors, visitors, and the public from hazards associated with hazardous waste and emergency response operations in accordance with 29 CFR 1910.120 and applicable State regulations.

7.10 BASIC SANITATION

7.10.1 Key Requirement. Employers shall establish and maintain basic sanitation provisions for all employees in all places of employment. This includes, but is not limited to, potable water, toilet, and waste collection and removal system. Washroom, showers, and separate eating facilities should be provided as appropriate.

7.10.2 Potable water. An adequate supply of potable water shall be provided in all places of employment. Portable containers used to dispense drinking water shall be kept tightly closed, equipped with a dispensing tap, labeled as "**DRINKING WATER**," and maintained in a sanitary condition. Water shall not be dipped from any portable water container. Drinking directly from the container is prohibited unless a properly installed drinking fountain with guarded orifice is provided. Containers used to dispense or distribute drinking water shall not be used for any other purpose. Use of breakable cups or glasses is prohibited. Fountain-type dispensers or one-use cups shall be provided at each dispenser; a waste receptacle shall also be provided. Outlets dispensing nonpotable water shall be conspicuously posted, "**WATER UNSAFE FOR DRINKING PURPOSES**," on a caution sign. (Refer to sec. 9.)

7.10.3 **Toilet facilities.** Toilet facilities shall be provided at each jobsite in the following ratios:

<u>Number of Employees</u>	<u>Minimum Number of Units</u>
0 to 20	1 toilet, 1 urinal
21 to 199	1 additional toilet and urinal for each additional 40 employees
200 or more	1 additional toilet and urinal for each additional 50 employees

Under temporary field conditions, provisions shall be made to ensure that not less than one separate toilet facility is available for men and for women. Toilets will be within easy access to the worksite unless they are for a mobile crew and transportation is readily available.

a. *Portable toilet facilities.* When sewage disposal systems are not available, the following type toilet facilities shall be provided unless prohibited by local codes:

1. Chemical toilets,
2. Recirculating toilets, or
3. Combustion toilets.

b. *Design of portable toilets.* Toilets shall be designed to provide privacy and protection from weather and falling objects. Cracks shall be sealed and the door tight-fitting and self-closing. Toilets shall have adequate ventilation and light, and all windows and vents shall be screened.

c. *Chemical toilets.* Provision shall be made for routinely servicing and disposing of the sewage in accordance with Federal, State, and local health regulations.

d. *Sanitation.* Toilets shall be maintained in a clean and sanitary condition with adequate supply of toilet paper with holder for each stool. Provision shall be made for frequent inspection and maintenance of all toilet facilities.

7.10.4 **Garbage facilities.** Garbage shall be kept in substantial closed insect- and rodent-tight containers and collected not less than weekly. Garbage and similar refuse shall be disposed of in designated areas.

7.10.5 **Environmental contamination.** Garbage, refuse, waste materials, or sewage shall not be allowed to contaminate lakes, rivers, reservoirs, streams, ditches, or natural drainage.

7.10.6 **Eating facilities.** Food service facilities and operations shall comply with the codes and regulations of the jurisdiction in which they are located. Cafeterias, restaurants, mess facilities, and related operations located on construction sites shall be established, operated, and maintained in compliance with the health and sanitation recommendations of the U.S. Public Health Service and applicable State and local regulations.

a. *Food handler's certification.* Employees preparing or handling food shall undergo regular medical examinations and possess a food handler's certificate issued by the State or local government authority having jurisdiction. Such employees shall wear clean clothes and show evidence of cleanliness.

7.10.7 Sleeping facilities. Sleeping quarters shall comply with all applicable Federal, State, and local sanitation and fire protection codes.

a. *Fire protection.* Sleeping quarters constructed on the jobsite shall comply with the NFPA Life Safety Code 101.

7.10.8 Washing facilities. Adequate washing facilities shall be provided for all employees. Such facilities shall be near the worksite and furnished with cleaning materials which will remove the specific type of contaminant.

7.11 LABORATORY SAFETY

7.11.1 Key requirements. Employers with chemical laboratories having exposure or risk of exposure to hazardous chemicals shall develop a chemical hygiene plan and designate a responsible person to assure full compliance with OSHA standard 1910.1450.

7.12 BLOODBORNE PATHOGENS

7.12.1 Key requirements. Employers shall identify employees with job duties place them at risk of exposure to bloodborne pathogens and shall develop and implement an exposure control program consistent with 29 CFR 1910.1030. Bloodborne pathogen training shall be provided when first aid/CPR training is conducted.

7.13 VDT WORKSTATION ERGONOMICS

7.13.1 Key requirement. Employers shall provide VDT users with ergonomically safe workstations, train employees in their use, and evaluate usage.

7.14 SPECIAL PROGRAMS

7.14.1 Heat stress. Employees working in environments exceeding 32.2 °C (90 °F) dry bulb shall be indoctrinated in heat stress protective procedures and WBGT measurements initiated. When WBGT exceed 25.9 °C (78 °F) the work regiment in table 1 and figure 1 of the section "Heat Stress" in the latest edition of the ACGIH TLV Booklet should be followed. Advice of a consulting physician shall be obtained.

7.14.2 Cold Stress. Employees working in environments below 4 °C (40 °F) dry bulb shall be indoctrinated on proper insulating wearing apparel, hypothermia symptoms, and appropriate preventive measures. Employees should not be exposed to equivalent wind chill temperatures below -32 °C (-25.6 °F) dry bulb.

7.14.3 **Lighting.** Lighting shall be provided in accordance with the current ANSI/IES RP-7, American National Practice for Industrial Lighting; ANSI/IES RP-1, Practice for Office Lighting; and ANSI/UL 924, Emergency Lighting and Power Equipment.

7.14.4 **Ionizing Radiation.** Radioactive materials shall be stored, handled, used, and disposed in accordance with the controls and precautionary procedures prescribed in the NRC's (Nuclear Regulatory Commission) "Standards for Protection Against Radiation," Title 10, Code of Federal Regulations, Part 20. In no event shall employees be exposed to radiation levels exceeding the permissible limits set forth in this referenced regulation.

7.14.5 **Lasers.** The installation and use of lasers and laser systems shall comply with the manufacturer's requirements and restrictions in accordance with current ANSI Z136.1, American National Standard for the Safe Use of Lasers.

7.14.6 **Microwaves.** Employees shall not be exposed to microwave power densities in excess of 10 milliwatts per square centimeter for frequencies between 1 and 300 GHz. For exposure limits at other frequencies refer to the ACGIH TLV Booklet.

7.14.7 **Radon.** Occupied and unoccupied structures shall be tested for radon concentrations. Structures such as storage buildings, equipment storage garages, and dam galleries where personal exposures are infrequent and of only short duration are unoccupied structures. Occupied structures which have annual average radon levels in excess of the EPA action level of 4 pCi/l (0.02 WL) shall be mitigated and retested to determine that levels have been reduced to or below 4 pCi/l. Unoccupied structures with radon levels above the EPA action level should have warnings posted.

7.14.8 **Asbestos.** When contractor and/or Reclamation employees are at risk of exposure to asbestos in the workplace, the regulatory provisions of 29 CFR 1910.1001, 29 CFR 1926.58, or more stringent State standards shall apply.

7.14.9 **Insects, vermin, and snakes.** Protection from exposure to insects, vermin, or snakes shall include the following controls as are necessary to eliminate or reduce the hazard:

- a. Boots, hoods, netting, gloves, masks, or other necessary personal protection.
- b. Repellents, skin creams.
- c. Smudge pots and aerosols for protecting very small areas.
- d. Elimination of unsanitary conditions which propagate insects or vermin.
- e. Inoculation of exposed employees when recommended by the consulting physician.
- f. First aid and medical facilities available to treat infected employees.

g. Instruction in recognition and identification.

7.14.10 **POISONOUS PLANTS.** In areas where employees are exposed to poison ivy, oak, sumac, or other poisonous plants, the following protective measures shall be taken as appropriate:

a. Removal or destruction of the plants.

b. Protective clothing shall be worn.

c. Protective ointments provided.

d. Soap and water shall be available for washing exposed skin areas.

e. Approved first aid and medical facilities shall be available for treatment of infected employees.

f. Immunization shall be provided for exposed employees as recommended by the consulting physician.

g. Instruction in recognition and identification shall be provided.

Section 8

PERSONAL PROTECTIVE EQUIPMENT

8.1 GENERAL

8.1.1 **Requirement.** This section sets forth minimum personal protective equipment requirements and standards. The employer shall ensure availability, proper use, and maintenance of equipment specified in this section. Anyone refusing or repeatedly failing to use the required equipment and/or comply with procedural requirements shall be removed from the associated work assignments. Personal protective equipment shall conform to NIOSH and MSHA standards, and where applicable, those in referenced ANSI (American National Standards Institute) publications.

8.1.2 **Maintenance.** Personal protective equipment in use shall be inspected before each day's use and maintained in serviceable condition. Items of personal issue shall be cleaned, sanitized as appropriate, and repaired prior to being reissued to another employee.

8.2 HEAD PROTECTION

8.2.1 **Requirement.** Employees, including supervisors, manufacturer and supplier representative, and visitors, shall wear helmets (hardhats) of the type specified herein when entering or working in designated hardhat areas.

8.2.2 **Hardhat areas.** Hardhat areas shall include all areas where construction, maintenance, and repair work of any nature is in progress. The entire jobsite, with the exception of offices and parking areas, shall be considered hardhat areas.

8.2.3 **Posting of hardhat areas.** Conspicuous signs shall be erected at all entrances to sites designated as hardhat areas:

"HARDHATS REQUIRED BEYOND THIS POINT"

8.2.4 **Design.** Hardhats shall comply with class A or B design specifications of the current edition of ANSI Z89.1, "Requirements for Protective Headwear for Industrial Workers." Hardhats worn by linemen, electricians, or employees working in tunnels, shafts, or in the proximity of high-voltage conductors or apparatus shall conform to class B requirements of the standard. Metal hardhats or bump caps are not acceptable. Hardhats shall bear a manufacturer's label indicating design compliance with the appropriate class requirements.

8.2.5 **Winter protection.** Winter hardhat liners shall be provided when weather conditions warrant.

8.3 EYE AND FACE PROTECTION

8.3.1 **Requirement.** Employees exposed to potential eye or face injury from physical, chemical, or radiation agents shall be furnished and required to wear eye and/or face protection specifically designed for the exposure.

8.3.2 **Design.** Eye and face protection required by this section shall comply with the standards published in the current ANSI Z87.1, "Practice for Occupational and Educational Eye and Face Protection." Contact lenses do not provide eye protection and shall not be worn in a hazardous environment without appropriate covering safety eyewear.

8.3.3 **Corrective lenses.** Employees whose vision requires the use of corrective lenses, when required to wear eye protection, shall be protected by one of the following:

- a. Protective spectacles whose lenses provide optical correction.
- b. Protective goggles or face shields that can be worn over corrective glasses.
- c. Goggles that incorporate corrective lenses mounted behind protective lenses

8.3.4 **Selection guide.** Appendix A shall be used as a guide in the selection of eye and face protection for the hazards and operations noted.

8.3.5 **Electric welding.** Employees engaged in electric welding operations shall wear nonflammable welding helmets with lift-front or stationary-front lens. Plano prescription safety glasses or flash goggles shall be worn under the helmet to provide eye protection when the helmet is raised for scaling operations. Helmet filter lens shades shall conform with Appendix B.

8.3.6 **Gas-torch cutting and welding.** Employees engaged in gas-torch cutting and welding shall wear a welding mask, weld-view or cover-glass goggles, or similar goggles providing equivalent eye and face protection. The eye protectors shall be equipped with filter lenses conforming with Appendix B. The use of sun glasses to meet this requirement is prohibited.

8.3.7 **Welder helper or inspector.** Welder helpers or welding inspectors shall wear flash goggles with a minimum lens shade of 2 (app. B) in the general welding area. Helpers or inspectors observing actual welding operations shall wear the same protection as the welder.

8.3.8 **Laser protection.** The installation and use of lasers and laser systems shall comply with the manufacturer's requirements and restrictions in accordance with current ANSI Z136.1, "American National Standard for the Safe Use of Lasers." Persons exposed to Class 4 laser beams shall wear eye protection meeting the requirements contained in ANSI Z136.1.

8.4 RESPIRATORY PROTECTION

8.4.1 **General.** Harmful atmospheric contamination to employees shall be controlled to the extent feasible by accepted engineering control measures. When effective engineering controls are not feasible or while they are being instituted, appropriate respirators shall be used in accordance with a written respiratory protective plan. The plan must address:

- a. Documented workplace hazard assessment
- b. Air monitoring
- c. Medical surveillance
- d. Recordkeeping
- e. Administrative procedures
- f. Supervisor and employee training
- g. Respirator selection
- h. Respirator maintenance procedures
- i. Program evaluation

8.4.2 **Medical test.** No employee shall be assigned to tasks requiring respirator use until that employee has been found to be medically fit to wear the designated respirator.

8.4.3 **Fit test.** Quantitative fit testing shall be required for employees that wear a negative pressure respirator.

8.4.4 **Employee training.** Respirator users and their supervisor shall receive training in the proper use, selection, and maintenance of respirators.

8.4.5 **Respirator selection.** Respirator selection shall be in accordance with this subsection, the latest edition of ANSI Z88.2, "Practices for Respiratory Protection," and appendix C.

8.4.6 **Respiratory devices and air supply.** Only respiratory devices approved by NIOSH or MSHA shall be provided. Air for supplied air respirators or self-contained breathing apparatus shall meet at least the requirements for Grade D breathing air as described in "Compressed Gas Association Commodity Specification for Air," G7.1 (ANSI/CGA Z86.1). The air can be supplied from DOT-approved cylinders, breathing air pump. Cylinders shall be marked in accordance with ANSI Z48.1. Breathing air pumps shall be designed specifically for intended use and shall provide at least 4 cubic feet (115 liters) per minute of air for each. Air-line couplings shall be incompatible with outlets for other gas systems. Pumps will be designed and located so as to avoid entry of contaminated air into the system.

8.4.7 **Air-purifying respirators.** Employees working in atmospheres containing toxic gases, fumes, mists, vapors, or dust in concentrations exceeding the action levels of current PEL/TLVs, shall use respirators approved for the exposure encountered. This type of respirator shall not be used in atmospheres that are oxygen deficient. Filters shall be replaced as soon as breathing becomes difficult and cartridges shall be replaced as soon as odor or irritation is detected by the user.

8.4.8 Supplied air respirators. All employees working in confined areas where high concentrations of toxic substances are present in the atmosphere, but not immediately hazardous to life, shall wear supplied air respirators. Supplied air respirators shall also be worn by employees engaged in abrasive blasting, welding in confined space, spray painting with lead paints, applying clear resin curing compound, coal-tar enamels or other toxic coatings, or carcinogenic or suspected carcinogenic material unless adequate ventilation is provided and tests verify that toxic materials are maintained within limits required by paragraph 7.2.1.

8.4.9 Self-contained breathing apparatus. Employees entering or working in unknown atmospheres or atmospheres IDLH (immediately hazardous to life or health), due to toxic concentrations of airborne contaminants or oxygen deficiency shall wear positive pressure self-contained compressed-air breathing apparatus of an approved type. No employee shall enter such atmospheres unless accompanied by another adequately protected employee, or is wearing a safety line attended by a person wearing the same type of self-contained breathing apparatus. Employees shall be instructed and trained in the use of self-contained breathing apparatus prior to exposure to atmospheres hazardous to life. (See subsecs. 7.8 and 7.10 for additional requirements.)

Supplied air respirators with positive pressure regulators and emergency self-contained escape bottles may be used in lieu of self-contained breathing apparatus.

8.4.10 Self-contained oxygen breathing apparatus. Self-contained oxygen breathing apparatus may be approved for use in rescue operations conducted by a trained rescue crew.

8.4.11 Self-rescuer. Employees and others exposed to underground environments, such as tunnels and shafts, shall be provided with an approved self-rescuer device. Employees shall have satisfactorily completed an MSHA-approved self-rescue course or equivalent certified training prior to going underground. Visitors instructed in the operation of the self-rescuer and accompanied by a trained employee are exempt from this training.

8.5 HEARING PROTECTION

8.5.1 Requirement. When personnel are subjected to sound-pressure levels exceeding the limits specified herein, feasible engineering or administrative controls shall be utilized. If such controls fail to reduce sound-pressure levels within the specified limits, personal protective equipment shall be selected, evaluated, provided, and used in accordance with the hearing conservation program. Employees working in areas where noise levels equal or exceed 85 dBA shall be provided with ear protection.

8.5.2 Hearing conservation program. In operations where employees are exposed to harmful noise levels that equal or exceed 85 dBA TWA, employer shall initiate and conduct a hearing conservation program meeting the provisions of paragraph 7.7.4 of this manual.

8.6 PROTECTIVE CLOTHING

8.6.1 Welding leathers. Employees engaged in overhead welding or burning where severe burn hazard exists shall wear leather gloves, chrome-tanned leather chaps and coats, or combination of coats, sleeves, pants, etc., providing equal protection. Leather gloves and aprons shall be worn by employees performing routine welding and burning.

8.6.2 High-visibility apparel. All employees exposed to vehicular traffic shall wear high visibility orange apparel during daylight hours and reflective high visibility apparel with a minimum reflective area of 400 square inches after dark.

8.6.3 Gloves. Suitable impervious gloves shall be furnished by the employer and worn by employees handling acids, caustics, solvents, herbicides, and other toxic materials in accordance with the MSDSs. Employees shall wear leather-palm gloves when such gloves are essential for safe accomplishment of the work; i.e., when handling steelplates, cables, barbed wire, and rough-hewn timber.

8.6.4 Rubber goods. Rubber gloves, sleeves, blankets, covers, and line hose shall not be used unless required by special conditions for work on energized facilities. Rubber goods provided for the protection of employees engaged in work on energized facilities shall conform to ASTM (American Society of Testing and Materials) specifications. They shall be tested, inspected, and maintained in accordance with current ASTM standards.

8.6.5 Protective chaps. Protective chaps meeting current U.S. Forest Service requirements shall be worn by employees operating chain saws, hand-held abrasive wheel cutoff saws, and other similar power tools.

8.6.6 Foot Protection. Employees engaged in work having an inherent danger to feet or requiring special foot protection shall wear protective footwear meeting the requirements contained in ANSI Z41, "Protective Footwear." All such footwear shall be boots, minimum 6 inches high and meet the basic I/75 "impact," C/75 "compression" standards for the protective toe box. In addition, rubber footwear including boots and packs shall meet the sole puncture-resistance requirements, and heavy duty footwear shall meet the MT/75 metatarsal requirements. Examples of occupations and activities requiring foot protection and minimum acceptable level of protection are listed below:

Jack Hammer Operators	--	MT/75 Heavy duty footwear
Hand Compactor Operators	--	MT/75 Heavy duty footwear
Drillers	--	I/75, C/75 Protective Footwear
High Scalers	--	I/75, C/75 Protective Footwear
Welders/helpers	--	I/75, C/75 Protective Footwear
Iron workers	--	I/75, C/75 Protective Footwear
Riggers	--	I/75, C/75 Protective Footwear
Underground workers	--	I/75, C/75 Protective Footwear
Pipe layers	--	I/75, C/75 Protective Footwear

Oxfords, sandals, canvas, tennis, or deck shoes are not acceptable for field visits, operations and maintenance, and construction work. Athletic or oxford style low cut safety-toed shoes meeting the ANSI Z41 requirements for impact resistance may be worn in low hazard areas when approved by the COR or office head.

8.6.7 Minimum wearing apparel. In addition to other regulations of this paragraph, all employees will wear as minimum protection full-length pants and short sleeve or t-shirt, with a minimum 4-inch sleeve. Cutoffs, tank tops, or modified shirts, etc., are not acceptable wearing apparel.

8.7 SKIN PROTECTION

8.7.1 Requirement. Where irritants or toxic substances may come in contact with the skin or clothing, employees shall be protected by the following:

- a. Protective clothing and necessary eye and face protection and/or approved ointment or other remedies approved by the consulting physician
- b. Emergency eye flush fountain
- c. Emergency deluge shower

8.8 SAFETY BELTS, LIFELINES, AND PERSONAL FALL PROTECTION SYSTEMS

8.8.1 Requirement. Employees working on slopes steeper than 1-1/2 : 1 or subject to falls from heights of 6 feet or greater, not protected by fixed scaffolding, guardrails, or safety nets, shall be protected by a personal fall protection system meeting the requirements of this section.

8.8.2 Hardware. Connectors shall be drop forged, pressed, or formed steel or made of equivalent materials. The connectors shall have a corrosion-resistant finish and edges shall be smooth to prevent damage to interfacing parts of the system. Dee-rings and snap hooks shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN). Dee-rings and snap hooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.

a. *Snap-hooks.* Snap-hooks shall be dimensionally compatible with the member to which they are connected so as to prevent unintentional disengagement of the snap-hook by depression of the snap-hook keeper by the connected member, or they shall be a locking type snap-hook designed to prevent disengagement of the snap-hook by contact of the snap-hook keeper by the connected member.

b. *Use.* Unless of a locking type designed for the following connections, snap-hooks shall not be engaged:

- 1. Directly to webbing, rope, wire rope, or chain
- 2. To each other
- 3. To a dee-ring to which another snap-hook or other connector is attached

4. To a horizontal lifeline
5. To any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself.

8.8.3 Lanyards and Lifelines. Lanyards and vertical lifelines which tie off one employee shall have a minimum breaking strength of 5,000 pounds (22.2 kN). Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet (.61 m) or less shall have components capable of sustaining a minimum static load of 3,000 pounds (13.3 kN) applied to the device with the lifeline or lanyard in the fully extended position. Self-retracting lifelines and lanyards which do not limit free fall distance to 2 feet (.61 m) or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN) applied to the device with the lifeline or lanyard in the fully extended position. Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system which maintains a safety factor of at least two. Restraint lines shall be capable of sustaining a tensile load of at least 3,000 pounds (13.3 kN). Life lines and carriers shall not be made of natural fiber rope, except natural fiber rope meeting the requirements listed below shall be used for high scaling operations.

- a. *High scaling lifelines.* Lifelines used for high scaling operations exposed to cutting or abrasion shall be 7/8-inch-minimum-diameter manila rope with wire core.
- b. *High scaling lanyards.* High-scalers working on vertical faces or steep slopes where balance cannot be safely maintained without support shall use two 5/8-inch-diameter manila rope lanyards independently attached to the lifeline. The lanyards will be attached to the lifeline by means of a scalers hitch as shown in appendix D.

8.8.4 Anchorages. Anchorages shall be capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, or shall be designed, installed, and used under the supervision of a qualified person as part of a complete fall protection system which maintains a safety factor of at least two.

- a. *High-scaling.* Lifelines shall be secured above the point of operation to at least two independent anchorages, each capable of supporting at least 5,000 pounds (22.2 kN). Anchorages shall be located at least 4 feet apart.
- b. *Rebar.* Anchorages shall not be made from drill steel or reinforcing bar.
- c. *Mobile anchorages.* Anchorages shall not be made to mobile equipment or other items capable of being moved while the anchorage is in use.

8.8.5 Procedures. Personal fall protection systems and their components shall be used only for employee fall protection. Lifelines, lanyards, belts, hardware, and anchorages shall be inspected each day prior to use. Questionable devices will be discarded. Use and care of fiber

lifelines and lanyards shall be in accordance with the more stringent of recommendations contained in *Rigging Manual* referenced in paragraph 17.1.1 and these standards.

- a. *Lifelines.* When vertical lifelines are used, each employee shall be provided with a separate lifeline.
- b. *Rescue.* Provisions shall be made for the prompt rescue of employees in the event of a fall or provisions shall be made to assure that employees are able to rescue themselves.
- c. *Protection.* Lifelines shall be protected against being cut or abraded.
- d. *Maintenance, inspection, testing.* Manufacturers' recommendations for maintenance, inspection, and testing shall be followed for all personal fall protection systems.
- e. *High-scaling.* Prior to starting high-scaling operations, a JHA addressing as a minimum the following items shall be developed in accordance with subsection 3.5:
 - 1. Emergency procedures including medical assistance.
 - 2. Personal protective equipment required including gloves, safety glasses, hardhat with chin strap, foul weather gear, etc.
 - 3. Procedures for protecting employees and the public from falling material.
 - 4. Methods for ensuring the safe entrance and exit from high-scaling operations.
 - 5. Proposed indoctrination and training programs for ensuring high-scalers' competency and knowledge of these requirements.
- f. *Training.* Before using personal fall protection systems and after any component or system is changed, employees shall be trained in the application limits of the equipment, proper hook-up, anchoring and tie-off techniques, methods of use, and proper methods of equipment inspection and storage.

8.8.6 Personal fall arrest system. A system used to arrest an employee in a fall from a working level consists of an anchorage, connectors, a body belt, or body harness and may include a lanyard, deceleration device, lifeline, or suitable combination of these.

- a. *Performance criteria.* Personal fall arrest systems shall, when stopping a fall:
 - 1. Limit maximum arresting force on an employee to 900 pounds (4 kN) when used with a body belt.
 - 2. Limit maximum arresting force on an employee to 1,800 pounds (8k N) when used with a body harness.

3. Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 m).

4. Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system, whichever is less.

b. *Performance test.* When used by employees having a combined person and tool weight of less than 310 pounds (140 kg), personal fall arrest systems which meet the criteria and protocol contained in 29 CFR 1910.66, appendix C, shall be considered as complying with these requirements.

c. *Use.* Personal fall arrest systems shall be rigged such that an employee can neither fall more than 6 feet nor contact any lower level. Personal fall arrest systems shall be worn with the attachment point for the body belt located in the center of the wearer's back and the attachment point of the body harness located in the center of the wearer's back near shoulder level or above the wearer's head. When connected to a horizontal lifeline which could become vertical, connectors shall be capable of locking in either direction on the lifeline.

d. *Maintenance.* Maintenance in accordance with the manufacturer's recommendations is a critical element in use of personal fall arrest systems and shall be followed. The employer shall have an onsite representative that has been certified and trained by the manufacturer as qualified to inspect and maintain personal fall arrest systems when in use on a project.

e. *Impact loading.* Whenever the personal fall arrest system has been subjected to shock loading, it shall be immediately removed from service and not used until it has been inspected and determined to be suitable for reuse by the onsite representative in paragraph "d." above.

8.8.7 Positioning device system. A system of equipment or hardware which, when used with its body belt or body harness, allows an employee to be supported on an elevated vertical surface, such as a wall or a rebar mat, and work with both hands free, or a device which is attached between the employee and an anchorage to prevent the employee from walking or falling off an elevated surface.

a. *Performance criteria.* Positioning device systems shall be capable of withstanding without failure a drop test consisting of a 4-foot (1.2-m) drop of a 250 pound (113-kg) weight.

b. *Performance test.* Positioning device systems which meet the test contained in appendix D shall be considered as complying with these requirements. Restraint line systems shall be designed to meet the same test requirements as other positioning device systems.

8.8.8 Personal fall protection system for climbing activities. Personal fall protection systems are worn or attached to an employee to protect an employee from being injured in a fall while ascending or descending.

a. *Design criteria for system components.* The system shall permit the employee using the system to ascend or descend without continually having to hold, push, or pull any part of the system, leaving both hands free for climbing. The connection between the carrier or lifeline and the point of attachment to the body belt or harness shall not exceed 9 inches (23 cm) in length. The system shall be activated within 2 feet (0.61m) after a fall occurs, in order to limit the descending velocity of an employee to 7 feet/s (2.1 m/s) or less.

b. *Performance criteria.* Ladder safety devices and their support systems shall be capable of withstanding without failure a drop test consisting of an 18-inch (0.41-m) drop of a 500 pound (226-kg) weight. All other personal fall protection systems for climbing activities shall be capable of withstanding without failure a drop test consisting of a 4-foot (1.2-m) drop of a 250 pound (113-kg) weight.

c. *Installation.* Mountings for rigid carriers shall be attached at each end of the carrier, with intermediate mountings as necessary, spaced along the entire length of the carrier to provide the strength necessary to stop employee falls. Mounting for flexible carriers shall be attached at each end of the carrier. When the system is exposed to wind, cable guides utilized with a flexible carrier shall be installed with a minimum spacing of 25 feet (7.6 m) and a maximum spacing of 40 feet (12.2 m) along the entire length of the carrier, to prevent wind damage to the system. The design and installation of mountings and cable guides shall not reduce the design strength of the ladder.

8.9 LINEMEN'S BELTS AND LIFELINES

8.9.1 Requirement. Linemen's body belts and safety straps shall be used when working above ground levels on wood poles, steel towers, communication towers, and other transmission line, substation, and switchyard structures.

8.9.2 Body belts, safety straps, and lanyards. Linemen's body belts, safety straps, and lanyards shall meet the design specifications published in the current revision of 29 CFR 1926.959, with compliance certified by the manufacturer.

8.9.3 Nonconductive rope lifelines. Nonconductive rope lifelines shall have a minimum diameter of 3/4 inch, a minimum breaking strength of 5,400 pounds, and shall be able to withstand an a-c dielectric test of not less than 25,000 volts per foot "dry" for 3 minutes without visible deterioration.

8.10 SAFETY NETS

8.10.1 Requirements. The employer shall install safety nets to protect employees when workplaces are more than 25 feet above adjoining surfaces where use of scaffolding, catch

platforms, temporary floors, safety belts and/or lifelines are impractical. When required or directed by the office head or the COR, safety nets shall be used to protect employees and/or the public exposed to hazards from overhead construction.

8.10.2 Net specifications. The mesh size of safety nets shall not exceed 6 by 6 inches. Nets shall meet accepted performance standards of 17,500 foot-pounds minimum impact resistance, as determined and certified by the manufacturer and shall bear a label of proof test. Edge ropes shall withstand a minimum breaking strength of 5,000 pounds. Nets installed for overhead protection shall be lined with wire or synthetic netting of not more than 1-inch mesh. Wire mesh shall be not less than No. 22 gauge, synthetic not less than No. 18 twine.

8.10.3 Installation. The net suspension system shall be designed and constructed with a minimum safety factor of four and shall withstand the test loading without permitting contact between the net and any surface or object below the net. Connections between panels shall develop the full strength of the net. Forged steel safety hooks or shackles shall be used to fasten the net to its supports.

8.10.4 Positioning. Safety nets shall be installed as close under the work surface as practical, but not over 25 feet below the working level. Nets shall extend at least 8 feet beyond the perimeter of the work area.

8.10.5 Testing. Safety nets shall be field tested immediately following installation, repositioning, or major repair. The test shall be conducted by dropping a 400-pound bag of sand not over 30 inches in diameter from a height of at least 25 feet onto the center of the net.

8.10.6 Inspection and maintenance. The care, maintenance, and storage of nets shall be in accordance with the net manufacturer's recommendations. Due attention shall be given to the factors affecting net life. (See para. 8.10.8.) Nets and debris shall be protected from sparks and hot slag resulting from welding and cutting operations. Nets shall be capable of a minimum service life of 2 years under normal on-the-job exposure to weather, sunlight, and handling, excluding damage from misuse, mishandling, and exposure to chemicals and airborne contaminants.

Nets shall be inspected daily for damage and necessary replacement or repairs shall be made before work above the net is resumed. Debris shall be removed from the nets at least daily. An up-to-date record shall be maintained for each personnel net. The record shall include the following information:

- a. Net serial number.
- b. Date installed.
- c. Dates inspected.
- d. Inspection results; if unsatisfactory, state reasons and describe corrections performed for each deficiency.
- e. Dates tested.
- f. Test results; if unsatisfactory, state reasons.

- g. Date removed.
- h. Disposition and reason.

The competent person responsible for the nets shall initial each entry.

8.10.7 Training. When personnel nets are used, the employer shall provide appropriate training for the employees so that they will recognize the hazards of falling into nets and shall instruct them in the procedures to be followed in order to limit the potential injury. The training program shall include:

- a. The tested limits of installed nets.
- b. Avoiding falls.
- c. Recording and reporting of training.
- d. Location of inspection records and the responsible person.

8.10.8 Factors affecting net life.

- a. *Sunlight.* Ropes of natural and synthetic fibers can lose a significant amount of strength after prolonged exposure to direct sunlight. Special precautions shall be taken to shield ropes 1/2 inch in diameter and smaller from the sun's rays. All nets not in use should be protected from direct and indirect sunlight.
- b. *Abrasion.* The adverse effects of abrasion should be constantly borne in mind. Nets should not be dragged or allowed to chafe over the ground or other rough surfaces. There is no test that will predict the life of a net under the wide variety of abrasion conditions that may be encountered.
- c. *Sand.* Embedded sand cuts into fibers reducing the strength of nets. Care should be taken to keep nets as clean and free of sand as possible.
- d. *Rust.* Prolonged contact with rusting iron or steel can cause significant degradation and loss of strength.
- e. *Airborne contaminants.* Many chemicals and airborne contaminants can adversely affect the strength of nets. Where such hazards to nets exist, the chemicals should be identified and the concentrations measured. The effect on the net materials should be determined by test, if not already known.

8.11 FLOTATION DEVICES

8.11.1 Requirement. U.S. Coast Guard-approved type III PFDs (personal flotation devices) or buoyant work vests shall be provided and worn by employees:

- a. On floating pipelines, pontoons, rafts, or float stages.

- b. On open deck floating plant not equipped with bulwarks, guardrails, or lifelines.
- c. On structures, cuts, cliffs, or banks extending over or adjacent to a water hazard, except where guardrails or safety nets are provided or employees are secured to lifelines.
- d. In skiffs, small boats, or launches except when inside an enclosed cabin or cockpit.

8.11.2 **Ring buoys.** Ring buoys approved by the U.S. Coast Guard with at least 90 feet of line shall be installed at 200-foot intervals on worksites where a water hazard exists.

8.11.3 **Inspection and replacement.** At regular intervals and after each use, personal flotation devices and buoyant work vests shall be inspected for defects which would compromise their safe use. Devices found to have less than 13 pounds buoyancy or are otherwise defective shall be replaced.

8.12 LIFESAVING SKIFFS

8.12.1 **Requirement.** One or more lifesaving boats or skiffs shall be provided at locations where men are working over or immediately adjacent to water where a drowning hazard exists. Persons trained in launching and operating the skiffs shall be immediately available during working hours. The skiffs shall be used only for drills and in emergencies.

8.12.2 **Equipment.** Lifesaving skiffs shall have the following equipment on board:

- a. Four oars (two if motor powered).
- b. Oarlocks attached to the gunwales or to the oars.
- c. One ball-pointed boat hook.
- d. At least one ring buoy with 90 feet of line attached.
- e. One life preserver or work vest for each person, but never less than a total of two.
- f. Emergency lighting.

8.13 OTHER PROTECTIVE EQUIPMENT

8.13.1 **Requirement.** Other protective equipment, fire and rescue devices, first aid and medical facilities, seatbelts, and special devices and equipment for protecting personnel from specific hazards are covered in other sections of this manual. Such specified protective equipment shall be worn by employees when exposed to the respective hazards.

Section 9

SIGNS, SIGNALS, AND BARRICADES

9.1 GENERAL

9.1.1 **Requirement.** This section establishes design specifications governing safety signs, tags, and barricades used on sites administered by the Bureau of Reclamation. Also, covered in this section are standard hoisting signals and provisions relating to the use of signalpersons.

9.2 SIGNS

9.2.1 **Application.** Signs described in this subsection shall be visible at all times when work is in progress and shall be promptly removed or covered when the hazard no longer exists.

9.2.2 **Standards.** In addition to the design specifications set forth in this subsection, the design and application of signs shall be in conformance with the latest edition of the following standards:

- a. ANSI Z535.2, "Environmental and Facility Safety Signs."
- b. OSHA 1910.145, "Specifications for Accident Prevention Signs and Tags."
- c. U.S. Department of Transportation Federal Highway Administration, "Manual on Uniform Traffic Control Devices for Streets and Highways (UTCD)."

9.2.3 **Danger signs.** Danger signs shall conform to the following requirements:

- a. *Application.* Danger signs shall be used only where there is imminent danger to the lives of employees or others.
- b. *Design.* As illustrated in figure 9-1, danger signs shall have red as the predominating color for the upper panel, black outline on the borders, and white lower panel for additional wording.
- c. *Sizes and specifications.* Specifications, including sign sizes, applicable to danger signs are set forth in paragraph 9.2.2.

9.2.4 **Caution signs.** Caution signs shall conform to the following requirements:

- a. *Application.* Caution signs shall be used to warn against potential hazard and to caution employees against unsafe practices.

b. *Design.* As illustrated in figure 9-2, caution signs shall have yellow as the predominating color, black upper panel and borders, yellow lettering of '**CAUTION**' on the black panel, and the lower yellow panel for additional wording in black.

c. *Sizes and specifications.* Refer to paragraph 9.2.2.

Figure 9-1. - Danger Sign

Figure 9-2. - Caution Sign

9.2.5 Exit and fire protection signs. Fire exits, fire protection equipment, and physical hazards shall be identified in accordance with ANSI Z535.1, "Safety Color Code," or NFPA No. 101, "Life Safety Code."

9.2.6 Instructional safety signs. Signs intended for general safety instructions or information shall be designed with a green upper panel and white lower section. White letters on the green background shall convey the principal message. Additional information shall appear in black letters on the white background.

9.2.7 Directional signs. Directional signs, other than traffic signs specified in paragraph 9.2.8, shall be white with a black panel and a white directional symbol. Directional information, if used, shall appear in black letters on a white background.

9.2.8 Traffic signs and barricades. Traffic signs and barricades shall conform to the following requirements:

a. *Design and use.* Traffic signs and barricades shall conform to the current Manual on UTCD (Uniform Traffic Control Devices). Signs and barricades erected by Reclamation or contractors on public highways and roads shall comply with the more stringent of the UTCD or State, county, city, highway, or street departments having jurisdiction.

b. *Gates and barricades.* The use of cable or single pole pipe barricades for gates is prohibited. Gates and barricades shall, as a minimum, meet the requirements for a type 1 barricade in section 6C-8 of UTCD.

c. *Installation and removal.* Appropriate traffic control signs and devices shall be erected prior to use of the roadway or area and promptly removed when no longer required.

d. *Visibility.* Signs and barricades shall be maintained clean and legible. Signs and barricades having any application at night shall be reflectorized or illuminated as appropriate. Signs and barricades shall be visible at all times and not obscured by parked equipment or other objects.

e. *Traffic controls.* When signs and barricades do not provide adequate protection, Reclamation, or the contractor (when directed by the COR), shall provide flagpersons or other appropriate traffic controls.

9.3 ACCIDENT PREVENTION TAGS

9.3.1 **Application.** Accident prevention tags are intended to warn employees and others of an existing hazard. They are intended for temporary use to warn of equipment under repair, defective tools, or equipment.

9.3.2 **Design.** Accident prevention tags shall conform to the current ANSI Z535.5, "Accident Prevention Tags." Appendix E illustrates accident prevention tags applicable to construction operations.

9.4 RADIATION WARNING

9.4.1 **Lasers.** Laser warning signs and symbols shall conform to the design specifications in the current issue of ANSI Z535.2, "Environmental and Facility Safety Signs," and ANSI Z136.1, "Safe Use of Lasers."

9.4.2 **Ionizing radiation.** Ionizing radiation warning signs and symbols shall conform to the design specifications in the current issue of ANSI Z535.2, "Environmental and Facility Safety Signs."

9.4.3 **Radio frequencies.** Signs warning of harmful radio frequencies shall display the standard warning symbol as described in the current issue of ANSI C95.2, "Radio Frequency Radiation Hazard Warning Symbol."

9.5 CRANE AND HOIST SIGNALS

9.5.1 **Application.** A uniform standard signal system shall be used in the operation of cranes, derricks, and hoists. Hand signals may be used when the distance between the operator and the signalperson is not over 200 feet. Radio, telephone, or a visual and audible electrically-operated system shall be used when the signalperson cannot be clearly seen by the operator or when the distance exceeds 200 feet.

9.5.2 **Hand signals.** When hand signals are used for the operation of cranes, derricks, and hoisting equipment, the signals shall conform to those illustrated in Appendix F, "Hand Signals for Cranes and Hoisting Equipment."

9.5.3 **Posting.** Signals shall be posted at the operator's position and, as practical, at signal control points and such other locations necessary to inform those using the signals.

9.5.4 **Signal systems.** Signal systems shall be protected from unauthorized use, damage, or interference. Crane and hoist signals will be given by a predesignated signalperson identified by special color of hardhat, armband, or other distinguishing marking.

9.6 TRAFFIC CONTROL SIGNALS

9.6.1 **Requirement.** Flagpersons directing traffic shall use the signals and procedures contained in the current issue of the UTCD. (See app. G.) The control of mechanized construction equipment during backing operations is specifically set forth in section 19.

9.7 SIGNAL AND FLAGPERSONS

9.7.1 **Requirement.** Only employees who are dependable, trained, qualified, and State certified, when applicable, shall be used as signal and flagpersons. Flagpersons controlling traffic shall wear high visibility apparel as described in paragraph 8.6.2.

9.8 BARRIER TAPE

9.8.1 **Requirement.** Plastic barrier tape can be an effective means to identify hazardous conditions or locations. When barrier tape is used, the individual in charge of the area will mark the tape with a barrier tag showing his/her name and phone extension.

9.8.2 **Red plastic tape.** Red plastic tape may be used to warn of dangerous conditions. Red plastic tape will mean **STOP, DANGER, or DO NOT ENTER**. Personnel working inside of the taped area will be instructed on the requirements of the JHA for the taped area. Other personnel requiring entry must obtain approval from the individual in charge of the area after a proper briefing. Crossing over or under a red barrier tape without proper authorization is forbidden.

9.8.3 **Yellow cloth tape.** Yellow cloth tape with a black tracer is a NEMA (National Electrical Maintenance Association) Standard for a high voltage barrier and shall mean the same as the red plastic tape. If used, the same restrictions on tagging and entry as shown above for red plastic tape shall be required.

9.8.4 **Yellow plastic tape.** Yellow plastic tape marked **CAUTION** will be used to identify hazards or conditions where caution is needed; i.e., tripping hazards, slippery conditions, pinch points, or chemical hazards. Barrier tape can be used to supplement required protection for a floor opening, but barrier tape by itself is not sufficient. The use of yellow plastic tape does not prevent employees from entering an area, but alerts them to hazards in the area.

Section 10

FIRE PREVENTION AND PROTECTION

10.1 **GENERAL.** This section sets forth requirements applicable to all activities under the administration of the Bureau of Reclamation. In addition to the requirements of this section, additional fire prevention and fire protection requirements relating to specific hazards and operations, welding and cutting, etc., are set forth in the appropriate sections of this manual.

10.2 FIRE PREVENTION

10.2.1 **Housekeeping.** Good housekeeping, with provision for prompt removal and disposal of accumulations of combustible scrap and debris, shall be maintained in all areas of the jobsite. Self-closing metal containers shall be used for collection of waste saturated with flammable and combustible liquids. Disposal shall be in accordance with hazardous waste regulations.

10.2.2 **Codes and regulations.** Reclamation and contractors shall comply with the requirements published in the current revisions of the National Electrical Code, National Electric Safety Code, and the National Fire Protection Association (NFPA) standards. NFPA 101, "Life Safety Code" shall be followed for design or remodel of any building to be occupied by employees or the public.

10.2.3 **Smoking.** Smoking or other sources of ignition shall not be permitted in areas where flammable or explosive materials are stored or are present, or in the vicinity of operations which constitute a fire hazard. All such areas shall be conspicuously posted: **NO SMOKING OR OPEN FLAMES.**

10.2.4 **Fires.** Fires and open flame devices shall not be left unattended unless protected with automatic temperature control and cutoff devices.

10.2.5 **Cleaning and degreasing.** Gasoline and liquids with a flashpoint below 100 °F shall not be used for cleaning and degreasing.

10.2.6 **Fireproofing.** When space does not permit adequate clearance between heating facilities and combustible materials, an approved 1-hour fire-resistive barrier shall be installed, providing a free flow of air between the barrier and flammable material.

10.2.7 **Explosive gases or vapors.** In areas where highly flammable or explosive gases or vapors may be present, necessary heat shall be provided through ductwork protected from the source of flame, or by steam or hot water heating systems, or electric heater approved for class 1, division 2 locations.

10.2.8 Buildings and structures. Nonfire-resistive buildings or structures shall be separated by a minimum distance of 25 feet. In a group of nonfire-resistive buildings with aggregate ground floor areas not exceeding 2,000 square feet shall be considered as one building for this purpose provided each building in the group is horizontally separated by at least 10 feet on each side from other buildings.

10.2.9 Building exits. All buildings, shops, and plant facilities in which employees are required to work shall have sufficient well-marked and lighted exits, as determined by NFPA 101, Life Safety Code.

10.2.10 Inspections. When the size and/or nature of the operation justifies, watchmen shall make frequent inspections of buildings, storage areas, employees' quarters, and work areas.

10.3 FIRE PROTECTION

10.3.1 Plan. Reclamation and contractors shall prepare a detailed fire protection plan.

- a. Reclamation projects and offices shall prepare and carry out an effective fire protection plan, including provisions for the fire protection and suppression equipment set forth in this section. The plan will be reviewed and approved by the office head.
- b. Contractors shall prepare and carry out an effective fire protection and prevention plan, including provisions for the fire protection and suppression equipment set forth in this section. When requested, the plan shall be submitted to and accepted by the COR prior to implementation.

10.3.2 Maintenance. Fire protection systems, alarms, and fire extinguishers shall be maintained in accordance with appendix I and NFPA standards.

- a. Fire fighting equipment shall be conspicuously located, or the location shall be marked by readily visible signs.
- b. Access to all fire fighting equipment shall be maintained at all times.
- c. Fire extinguishers shall be inspected at least monthly and a record kept, and they shall be maintained annually.
- d. Defective fire fighting equipment shall immediately be replaced.

10.3.3 Fire extinguishers. Distinctly marked fire extinguishers rated 2-A:40-B:C or greater shall be suitably placed as follows:

- a. One for each 3,000 square feet of building area or major fraction thereof. Travel distance from any point of a protected area to nearest extinguisher shall not exceed 100 feet.

- b. One or more on each floor of buildings with at least one located adjacent to each stairway.
- c. At least one located outside, but not more than 10 feet from the door opening into any room used for storage of more than 60 gallons of flammable or combustible liquids.
- d. At least one located no less than 25 feet, nor more than 75 feet from any outside flammable or combustible liquid storage area.
- e. At least one within 50 feet of wherever more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas is being used.
- f. Two or more on all tank trucks and service trucks used for transporting and/or dispensing flammable or combustible liquids.

Note: Carbon dioxide extinguishers having a rating of not less than 20 B:C can be substituted for A:B:C extinguishers in rooms or near cabinets housing electronic or electrical equipment. Such substitutions shall not reduce overall protection below minimums stated previously. Carbon tetrachloride or other toxic vaporizing liquid extinguishers; or brass and fiberglass shell stored water and/or antifreeze; brass or copper shell dry chemical, soda-acid, or foam extinguishers; or cartridge operated water or loaded steam extinguishers are prohibited.

10.3.4 Fire brigades. When community fire department services are not available or are insufficient, a trained firefighting organization meeting NFPA criteria shall be provided. Mobile and fixed firefighting equipment shall be provided and installed in accordance with NFPA recommendations.

10.3.5 Restricted use. Firefighting equipment shall be operative at all times and shall not be used for purposes other than extinguishing fires or fire brigade training.

10.3.6 Sprinkler protection. When sprinkler systems are provided, they shall be designed and installed in accordance with NFPA 13, "Standard for the Installation of Sprinkler Systems."

10.3.7 Fire alarm devices. A reliable fire alarm system, when required, shall be installed for the purpose of alerting employees exposed to fire danger and alerting the local fire department in an emergency. These devices shall be installed as soon as practicable, with reporting and evacuation instructions conspicuously posted on the jobsite.

10.3.8 Offsite assistance. The following requirements shall be met in arranging for offsite assistance:

- a. *Written agreement.* If outside normal service area, a written agreement covering the nature and type of assistance available should be secured if possible. Otherwise, a letter

shall be provided the CO stating the nature of the assistance together with details covering the equipment and personnel to be made available.

b. *Standpipe and hydrant connections.* When offsite assistance is provided, standpipe and hydrant connections shall be compatible with the equipment available from the fire department providing the assistance.

c. *Reporting.* Emergency telephone numbers and reporting instructions shall be posted on the jobsite.

10.3.9 Water supply. A temporary or permanent water supply with volume and duration of flow and pressure sufficient to supply the standpipes, hose stations, and/or sprinkler systems shall be installed prior to, or concurrently with, the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, the standpipe shall be connected to the water supply, installed concurrent with the structure, and maintained in operable condition for fire protection use. The standpipes shall be provided with siamese fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location at street or road level.

10.4 BURNING AREAS

10.4.1 Approval. Where it is necessary to dispose of combustible waste by onsite burning, designated burning areas shall be established in a location acceptable to the COR or Reclamation office head. Establishment of burning areas and disposal methods shall be in compliance with Federal, State, or local regulations and guidelines. Reclamation and the contractor shall coordinate burning with the Government agencies responsible for monitoring fire danger in the area.

10.4.2 Controlled burning. A sufficient number of employees and equipment shall be maintained at the designated burning site to properly control the operation and to prevent the spread of fire.

10.5 TEMPORARY HEATING DEVICES

10.5.1 General. The following requirements shall govern the use of temporary heating devices:

a. *Approval.* Only temporary heating devices accepted by the office head or the COR shall be used. Acceptance requests will include the following items:

1. Proposed placement including distance from combustibles
2. Service and maintenance and surveillance schedules
3. Proposed fuel storage and refueling system
4. Method for prompt detection of gaseous contamination or oxygen deficiency

Note: See paragraph 10.5.5 for restricted use of solid fuel heating devices.

b. *Data plates.* Each heater shall have permanently affixed to it a data plate providing the following information:

1. Required clearances
2. Ventilation requirement
3. Fuel type and input pressure
4. Lighting and extinguishing instructions
5. Electrical power supply characteristics

c. *Wood floors.* Heaters not suitable for use on wood floors shall be so marked and shall not be set on combustible materials. When such heaters are used, they shall rest on suitable noncombustible material equivalent to at least 1 inch of concrete. The noncombustible material shall extend to at least 2 feet beyond the heater in all directions.

d. *Combustible covering.* Heaters used in the vicinity of tarpaulins, canvas, or similar combustibles shall be located at least 10 feet from such combustibles. The coverings shall be securely fastened or tied down.

e. *Stability.* Heaters shall be set on level surfaces and located so as to minimize danger of upset.

f. *Installation.* Temporary heaters shall be installed, vented, and operated in accordance with manufacturer's instructions.

g. *Spark arresters.* Spark arresters shall be installed on smokestacks which could otherwise permit sparks to escape.

10.5.2 Liquid-fueled heaters. The following requirements shall govern the use of liquid-fueled heaters.

a. *General.* Liquid-fueled heaters may be either direct or indirect fired. Permissible fuels are kerosene, stove oil, fuel oil, coal oil, and diesel oil. The flashpoint of the fuel shall not be less than 100 °F.

b. *Stability.* Liquid-fueled heaters shall be either securely anchored or located so as to prevent upset.

c. *Design.* Liquid-fueled heaters shall be equipped with an automatic flame loss device which will prevent the flow of fuel when the flame is extinguished.

d. *Fueling.* Employees assigned to fueling shall be trained and thoroughly familiar with the manufacturer's instructions for operation and fueling of the heater. Prior to fueling, the heater shall be extinguished and permitted to cool to touch. Fuel shall be stored in and dispensed from covered approved-type flammable liquid containers.

e. *Maintenance.* Heaters shall be maintained in good operating condition. Provisions shall be made for periodic cleaning of oil reservoirs, jets, and other parts as specified by manufacturer.

f. *Grounding.* All noncurrent-carrying metal parts of heaters shall be electrically bonded and grounded.

10.5.3 Natural gas heaters. The following requirements shall apply to the use of natural gas heaters:

a. *General.* Natural gas heaters shall be installed, operated, and maintained in accordance with the manufacturer's instructions.

b. *Stability.* Heaters shall be securely anchored to prevent upset or movement.

c. *Piping.* Piping, tubing, or hose shall be leak tested after installation, using a safe detection means such as soapsuds. When flexible gas supply lines are used, they shall not exceed 25 feet in length. Supply lines and hose shall have a minimum working gauge pressure of 250 pounds per square inch, a minimum burst gauge pressure of 1,250 pounds per square inch, and a pull test of 400 pounds without leakage.

d. *Fuel cutoff.* Heaters shall be equipped with an automatic flame loss device which will shut off the gas supply if the flame or pilot is extinguished.

e. *Grounding.* All noncurrent-carrying metal parts of fan-assisted heaters shall be electrically bonded and grounded.

10.5.4 LPG (liquefied petroleum gas) heaters. The following requirements shall govern the use of LPG heaters:

a. *General.* LPG heaters shall be installed, operated, and maintained in accordance with the manufacturer's instructions. Containers and heating devices shall not be used, located, or stored below grade.

b. *Protection.* Heaters, when in use, shall be protected from damage by location, anchoring, or barricading.

c. *Testing.* Piping, tubing, and hose connections shall be leak tested following installations, using a safe detection device such as soapsuds.

d. *Hoses.* Only hose labeled LP-gas or LPG shall be used. Hose shall have a minimum working gauge pressure of 250 pounds per square inch and a minimum burst gauge pressure of 1,250 pounds per square inch. If LP-gas is supplied to the heater by a hose supply line, the hose shall not be less than 10 feet in length nor more than 25 feet. Shorter hoses may be used with heaters as described in subparagraph 10.5.4.i.(2).

e. *Hose connection.* Hose, pipe, and tubing connections shall be threaded and capable of withstanding, without leakage, a gauge test pressure of not less than 500 pounds per square inch and a pull test of 400 pounds.

f. *Regulator.* Heaters shall be equipped with an approved regulator between the cylinder and the supply line.

g. *Check valve.* Fuel cylinder connectors shall be provided with an excess flow check valve to minimize the flow of gas in the event the fuel line is ruptured.

h. *Fuel cutoff.* Heaters shall be equipped with an automatic flame loss device which will shut off the gas supply if the flame or pilot is extinguished.

i. *Fuel supply in buildings.* Gas cylinders shall be permitted in buildings or structures only in accordance with the following provisions:

1. The maximum water capacity of individual cylinders shall not exceed 245 pounds (nominal 100 pounds LPG capacity).

2. For temporary heating, such as curing concrete, drying materials, and similar uses, heaters (other than integral heater-container units) shall be located at least 6 feet away from any LPG container. This shall not prohibit the use of heaters specifically designed for attachment to the container or to a supporting structure with connecting hose less than 6 feet, provided the system is designed and installed to prevent direct applications of radiant heat from the heater onto the container. Blower-type or radiant heaters shall not be directed toward any LPG container within 20 feet.

3. When two or more heaters are located in an unpartitioned area on the same floor, the LPG containers supplying the respective units shall be separated by at least 20 feet.

4. LPG containers manifolded together supplying one or more heaters in an unpartitioned area on the same floor shall not exceed 300 pounds nominal LPG capacity. Such manifolds shall be separated by at least 20 feet.

5. On floors on which heaters are not connected for use, containers are permitted to be manifolded together for connection to one or more heaters located on another floor provided that: (a) the total nominal capacity of containers connected to any one manifold shall not exceed 1,000 pounds LPG, and (b) where more than one manifold having a nominal capacity exceeding 300 pounds LPG is located in the same unpartitioned area, the manifolds shall be separated by at least 50 feet.

j. *Refilling containers.* LPG containers shall not be refilled inside of buildings or structures. Refilling of containers shall be performed in accordance with paragraph 11.14.8.

k. *Storage of containers.* LPG containers not in use shall be stored outside in accordance with the minimum distances set forth in paragraph 11.14.9.

l. *Grounding.* Fan-assisted heaters shall be grounded and bonded, and electric motors used in such systems shall be grounded and connected to a grounded electrical supply.

10.5.5 **Restricted use.** The following restrictions shall apply to the use of temporary devices:

a. *Open flame-type heaters.* Use of open flame-type heating devices having exposed fuel below the flame is prohibited unless the units are an approved type, installed and operated in accordance with the approval and are acceptable to the COR or office head.

b. *Lubrication or service areas.* Heating equipment of an approved type may be installed in lubrication or service areas where flammable liquids are not dispensed or transferred, provided the bottom of the heater is at least 18 inches above the floor and protected from damage. When flammable liquids are dispensed in such areas, the heater shall be of a type approved for garages and installed at least 8 feet above the floor.

c. *Tunnels and shafts.* LPG heaters or natural gas heaters, piping or storage tanks shall not be permitted in tunnels, shafts, siphons, or similar below grade locations.

Section 11

MATERIAL HANDLING, STORAGE, AND DISPOSAL

11.1 OPEN YARD STORAGE

11.1.1 **Combustible materials.** Combustible materials shall be stacked securely, and stacks or piles shall not exceed 16 feet in height. No combustible material shall be stored within 10 feet of a building or structure.

11.1.2 **Access.** Driveways between and around combustible storage piles shall be at least 15 feet wide and shall be maintained free from accumulations of material or rubbish. Driveways in open-yard combustible material storage areas shall be planned with a maximum grid system unit of 50 by 150 feet.

11.1.3 **Powerlines.** Materials shall not be stored under overhead powerlines.

11.1.4 **Fire protection.** Portable fire extinguishing equipment rated 2-A:40-B:C shall be provided at accessible marked locations in the yard so that maximum travel distance to nearest unit does not exceed 100 feet.

11.1.5 **Sling hoisting.** Bagged material, lumber, bricks, masonry blocks, and similar materials shall not be hoisted by slings unless secured against falling by straps, sideboards, nets, or other suitable devices that fully secure the load.

11.1.6 **Taglines.** Taglines shall be used for controlling loads when hoisting materials near personnel, structures, or equipment.

11.2 INDOOR STORAGE

11.2.1 **General.** Materials shall be stored in a planned and orderly manner, so as not to endanger the safety of employees. Stacks, tiers, and piles shall be stable, and stacked to facilitate safe handling and loading. Storage of hazardous materials shall be in accordance with the requirements contained in the MSDS.

11.2.2 **Access.** Materials shall not be placed or stored so as to interfere with accessways, doorways, or hoistways. Accumulations of scrap or materials shall not be permitted to obstruct accessways and exits. Aisle width shall be adequate to accommodate firefighting equipment.

11.2.3 **Fire prevention.** Materials shall be stored, handled, and piled with consideration for their fire characteristics. Noncompatible materials which may create a fire hazard shall be separated by a distance of at least 25 feet or isolated by a barrier having at least a 1-hour fire

rating. Material shall be piled to minimize the spread of fire internally and to provide convenient access for firefighting.

11.2.4 Fire doors. A clearance of 24 inches shall be maintained around the path of travel of fire doors.

11.2.5 Sprinklers. Clearance of at least 18 inches shall be maintained between stored materials and sprinkler heads.

11.2.6 Fire protection. Fire protection shall be furnished in compliance with section 10 and as specified in other parts of this section.

11.2.7 Floor loading. Except for floors or slabs on grade, the maximum safe load limits in pounds per square foot shall be conspicuously posted in all indoor storage areas and shall not be exceeded.

11.2.8 Buildings under construction. Materials stored inside buildings under construction shall not be placed within 6 feet of any hoistway or inside floor openings, nor within 10 feet of an exterior wall which does not extend above the top of the material stored.

11.3 BAGGED MATERIAL

11.3.1 Stacking. Bagged materials shall be stacked by stepping back the layers and cross-keying the bags at least every 10 bags high, except when restrained by walls or partitions of adequate strength.

11.4 BULK STORAGE

11.4.1 Entrance. Silos, hoppers, tanks, bins, and similar bulk storage containers are considered confined spaces. No employee will enter such spaces until appropriate requirements in subsection 7.8 are implemented.

11.5 LUMBER

11.5.1 Stability. Lumber shall be stacked on level and solidly supported sills so that the stacks are stable.

11.5.2 Height. Lumber piles shall not exceed 16 feet in height.

11.6 BRICKS AND MASONRY BLOCKS

11.6.1 Stability. Brick and masonry blocks shall be stacked on level and solid surfaces.

11.6.2 **Brick.** Brick stacks shall not exceed 7 feet in height. When a loose brick stack reaches a height of 4 feet, it shall be stepped back at least 2 inches in every foot of height above the 4-foot level. Unitized brick shall not be stacked more than three units in height.

11.6.3 **Masonry blocks.** Masonry blocks stacked higher than 6 feet shall be stepped back one-half block per tier above the 6-foot level.

11.7 CEMENT AND LIME

11.7.1 **Cement and lime.** Employees handling cement or lime must participate in a job hazard analysis (JHA) including exposure determination. They shall wear appropriate personal protection equipment as specified in section 8 and identified in the JHA. Washing facilities, handcream, petroleum jelly, or similar preparations for protection from dermatitis shall be provided.

11.7.2 **Lime.** Unslaked lime shall be stored in a dry area, and due to fire hazard shall be separated from other materials.

11.8 REINFORCING, SHEET, AND STRUCTURAL STEEL

11.8.1 **Stacking.** Steel shall be safely stacked to prevent sliding, rolling, spreading, or falling.

11.8.2 **Lagging.** When steel is handled by a crane or forklift, lagging shall be used to facilitate safe rigging.

11.9 PIPE, CONDUIT, AND CYLINDRICAL MATERIAL

11.9.1 **Stacking.** Pipe, conduit bar stock, and other cylindrical materials shall be placed in racks, or stacked on a firm, level surface and blocked to prevent spreading, rolling, or falling. Either a pyramided or battened stack shall be used. Battened stacks shall be stepped back at least one unit per tier and securely chocked on both sides of the stack.

11.9.2 **Removal.** Removal of pipe or conduit from a stack shall be done from the ends of the pipe or conduit.

11.9.3 **Unloading.** Unloading from a carrier shall be done in such a manner that no person shall be exposed to the unsecured load.

11.10 WOOD POLES AND PILING

11.10.1 **Stacking.** Wood poles and round piling shall be stacked and handled as specified in subsection 11.9.

11.10.2 **Taglines.** Taglines shall be used when lifting poles or piling.

11.11 SAND, GRAVEL, AND CRUSHED STONE

11.11.1 **Stockpiles.** Stockpiles shall be located so as to provide safe access for withdrawing material. Overhanging of material or vertical faces shall not be permitted.

11.11.2 **Bins and partitions.** Material stored against walls or partitions shall not be stored in an amount which will endanger the stability of the wall or partition.

11.12 FLAMMABLE AND COMBUSTIBLE LIQUIDS

11.12.1 **General.** Unless defined herein, terms used throughout this subsection shall convey the meaning specified in the flammable and combustible liquids code, NFPA 30, or 29 CFR 1910.106.

a. For the purpose of this standard, flammable and combustible liquids are classified as follows:

1. Flammable liquids (Class I liquids):

Class I---Liquids having a flashpoint below 100 EF (38 EC)

Class IA---Flashpoint below 73 EF (23 EC) and boiling point below 100 EF (38 EC)

Class IB---Flashpoint below 73 EF (23 EC) and boiling point at or above 100 EF (38 EC)

Class IC---Flashpoint at or above 73 EF (23 EC) but below 100 EF (38 EC)

2. Combustible liquids (Class II and III liquids):

Class II---Liquids having a flashpoint at or above 100 EF (38 EC) and below 140 EF (60 EC)

Class III---Flashpoint at or above 140 EF (60 EC)

b. *Common flammable and combustible liquids.* Appendix J lists the classification and pertinent characteristics of commonly used flammable and combustible liquids.

c. *Class IA flammable liquids.*

1. **Restricted use.** Due to extreme explosion hazard of Class IA liquids, they shall not be purchased until storage, dispensing, and use procedures have been approved. Submittals for approval shall state the name and description of the liquid, its characteristics, and a detailed description of its intended use, together with the health and safety precautions to be used. This requirement shall not apply to small quantities of starter fluid.

2. **Substitute product.** Wherever practical, a less hazardous product shall be used.

3. **Controlled use.** Storage, dispensing, and use of Class IA liquids, including design of the storage and dispensing system under the supervision of a competent person.

d. *Toxicity of flammable and combustible liquids.* Most flammable and combustible liquids are highly toxic and should not be used until their toxic characteristics have been determined. The appropriate health and safety requirements set forth in section 7 shall be followed in handling toxic liquids.

e. *Closed tanks and containers.*

1. **Approved types.** Only the following type, approved and labeled, closed tanks and containers shall be used for storage, handling, and dispensing of flammable and combustible liquids.

(a) *Original container.* Flammable and combustible liquids may be stored and used in the original DOT shipping containers, as shown in table 11-1. However, the quantity in the work area shall not exceed 1-days usage, up to a maximum of 25 gallons of a Class 1A liquid or a maximum of 120 gallons of any other class of liquid. If flammable and combustible liquids are dispensed and used in smaller quantities, they shall be dispensed into properly labeled approved safety containers. **Exception:** Liquids which are highly viscous (extremely hard to pour) may be stored and handled in any size original container; and liquids which are transferred from labeled containers to portable containers and are intended only for the immediate use by the employee who performs the transfer are exempt from labeling.

Table 11-1 - Maximum Allowable Size of Containers and Portable Tanks Combustible

Container type	Flammable liquids		Liquids		
	Class IA	Class IB	Class IC	Class II	Class III
Glass	1 pt	1 pt	1 pt	1 pt	15 gal
Metal (other than approved Dot Drums) or approved plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal Drums (DOT Spec)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved Portable Tanks	660 gal	660 gal	660 gal	660 gal	660 gal
Polyethylene DOT spec 34, or as authorized by DOT exemption	1 gal	5 gal	5 gal	60 gal	60 gal

*Class IA refer to 11.12.1c.(1)

(b) *Safety can.* "Safety can" shall mean an approved container of not more than 5-gallon capacity having a spring-closing lid, spout cover, internal safety screen, and so designed that it will safely relieve internal pressure when subjected to fire exposure.

(c) *Drum/barrel.* The term "drum" or "barrel" shall mean an approved container having a capacity greater than 5 gallons and no more than 60 gallons.

(d) *Portable tanks.* The term "portable tank" shall mean an approved closed storage vessel having a capacity over 60 gallons and no more than 660 gallons and not intended to be a fixed installation.

(e) *Tanks.* The term "tank" shall mean an approved storage vessel having a capacity exceeding 660 gallons.

f. *Approved storage cabinets.*

1. **General design and construction.** Storage cabinets shall be designed and constructed to limit the internal temperature at the center, 1 inch (25.40 mm) from the top, to not more than 325 °F (162.8 °C) when subjected to a 10-minute fire test with burners simulating a room fire exposure using the standard time-temperature curve as given in ASTM E152-81a. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. All cabinets shall be labeled in conspicuous lettering **'FLAMMABLE---KEEP FIRE AWAY.'**

2. *Approved cabinets.*

(a) **Metal cabinets.** The bottom, sides, and top shall be at least No. 18 gauge sheet steel and double walled with 1-1/2 inch (38.1 mm) air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three-point latch arrangement and the door sill shall be raised at least 2 inches (50.8 mm) above the bottom of the cabinet to retain spilled liquid within the cabinet.

(b) **Wooden cabinets.** The bottom, sides, and top shall be constructed of exterior grade plywood at least 1 inch (25.40 mm) in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbetted and shall be fastened in two directions with wood screws. When more than one door is used, there shall be a rabbetted overlap of not less than 1 inch (25.40 mm). Doors shall be equipped with a means of latching, and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire exposure. A raised sill or pan capable of containing a 2-inch (50.8 mm) depth of liquid shall be provided at the bottom of the cabinet to retain spilled liquid within the cabinet.

- (c) All listed cabinets which have been constructed and tested in accordance with paragraph 11.12.1 f(1).

11.12.2 Storage

- a. *Indoor storage.* Flammable and combustible liquids will not be stored indoors except as follows:

1. No more than 25 gallons shall be stored in a room or single fire area.
2. No more than 60 gallons of Class I or II liquids, nor more than 120 gallons at Class III liquids, may be stored in an approved cabinet. No more than three such cabinets may be located in a single fire area.
3. Larger quantities may be stored in separated indoor storage areas when such storage is certified by a competent person to meet the requirements of NFPA 30, Section 4-4, "Design, Construction, and Operation of Separate Inside Storage Areas."
4. At least one 2-A:40-B:C fire extinguisher shall be located not less than 10 feet nor more than 25 feet from the stored material, cabinet, or entrance to the inside storage area.

- b. *Outdoor storage.*

1. Flammable and combustible liquids will not be stored outdoors except as follows:

- (a) Stored above ground in approved containers not exceeding 60-gallon capacity subject to the following restrictions:

(1) Any one group of containers stored together shall not exceed 1,100 gallons. Each group of containers shall be separated by at least 5 feet and no group shall be within 25 feet of any building or other combustibles.

(2) Each group of containers shall be located adjacent to an accessway at least 12 feet wide to facilitate the use of firefighting equipment.

- (b) Stored above ground in approved portable tanks not exceeding 660-gallon capacity providing:

(1) That groups of two or more tanks having a combined capacity over 2,200 gallons are separated by a 5-foot clear area.

(2) Portable tanks are not located within 25 feet of a building or combustible material.

(3) Portable storage tanks are equipped with emergency venting and other devices as required in NFPA 30.

(4) Each tank is located adjacent to an accessway at least 12 feet wide to facilitate use of firefighting equipment.

(c) Above ground in approved tanks installed in accordance with NFPA Section 2-2, "Installation of Outside Above Ground Tanks."

2. Storage areas shall be diked at least 12 inches high, or graded and sloped, and sealed with a 50 mil plastic or equivalent liner to permit containment of leaks and spills equal to the capacity of all tanks and/or containers located in each area. Further, the area is maintained free of weeds or combustible material to a distance of 10 feet out from the storage area perimeter.

3. At least one portable fire extinguisher rated not less than 2-A:40-B:C unit is located not less than 25 feet nor more than 75 feet from each portable tank or group of tanks or containers located outside.

11.12.3 Handling and dispensing flammable or combustible liquids

a. *Dispensing area.* Areas in which flammable or combustible liquids are transferred in quantities greater than 5 gallons at a time shall be separated from other operations by at least 25 feet, or by a partition having a minimum 1-hour fire rating. Drainage or an equally effective method shall be used to contain spills.

b. *Ventilation.* Adequate natural or mechanical ventilation shall be provided in order to maintain the concentrations of flammable vapor at below 10 percent of the lower flammable limit.

c. *Grounding.* The transfer of Class I flammable liquids from one container to another shall require bonding of the containers and the transfer system. All dispensing systems shall be electrically grounded and bonded.

d. *Dispensing.* Flammable and combustible liquids shall be drawn from or transferred into vessels, containers, or tanks, only (1) through a closed piping system, (2) from safety cans, (3) by means of a device drawing through the top, or (4) from containers or tanks by gravity or pump through a self-closing valve. Transferring by injecting pressurized air into a tank or container is prohibited.

e. *Lighting and electrical equipment.* Electrical lighting shall be the only means used to provide artificial illumination in areas where Class I flammable liquids are handled or dispensed, or where flammable vapor may be present. The wiring and all electrical equipment shall meet the requirements of NFPA designation: Class I, Division 2, of the National Electrical Code.

f. *Covered containers.* Class I and II liquids shall be kept in covered containers when not in use.

g. *Flame and ignition.* Open flame, smoking, or other sources of ignition shall not be permitted within a distance of 50 feet from areas where Class I flammable liquids are dispensed or used. Greater distance may be necessary under some conditions. Approved "**No Smoking**" signs shall be posted in such areas.

h. *Leakage or spillage.* Leakage or spillage of flammable or combustible liquids shall be cleaned up promptly and disposed of safely.

i. *Refuse containers.* Self-closing metal refuse containers shall be available in all areas where flammable or combustible liquids are dispensed or used.

11.12.4 Refueling

a. *Equipment.* Tanks and equipment used for refueling vehicles and equipment, fueled with flammable or combustible liquids shall be designed and installed in accordance with the applicable provisions of the NFPA Standards, Underwriters Laboratories, Inc., or Factory Mutual Standards, or have the approval of the Government agency having jurisdiction.

b. *Tank truck.* Tank trucks shall comply with the requirements published in NFPA 385, "Standard for Flammable and Combustible Liquid Tank Vehicles."

c. *Dispensing hose.* Hoses used to dispense flammable and combustible liquids shall be an approved-type with an automatic self-closing valve or nozzle without a latch-open device. A hanger or hose retracting system will be provided to protect the hose from traffic abuse.

d. *Electrical equipment.* Electrical wiring, pumps, and equipment shall meet the appropriate requirements of NFPA designation: Class I of the National Electrical Code. Clearly identified and accessible switches shall be provided at a location remote from dispensing devices to shut off all power to devices in an emergency.

e. *Refueling equipment.* Vehicles or equipment using gasoline, LPG, or other flammable or combustible liquid fuels shall be shut down during refueling. Diesel equipment is excepted when fueled in accordance with manufacturer's recommendations. Stationary refueling tanks and/or dispensing islands and pumps shall be protected against vehicular damage by guardrails or posts.

f. *Smoking.* A standard "**No Smoking**" sign shall be posted on all mobile refueling equipment and in established refueling areas.

11.13 ASPHALT AND TAR PRODUCTS

11.13.1 **Requirement.** Employees handling or working with these materials shall participate in the JHA process with documented exposure determinations. The manufacturer's Material Safety Data Sheets (MSDS) shall be made available and followed in the storage, handling, and application of these materials.

11.13.2 **Protective clothing and equipment.** Protective clothing, respiratory protection, and skin protection as specified in section 8 shall be given full consideration to protect employees handling or applying these materials.

11.13.3 **Confined spaces.** In enclosed or confined areas in which hot tar, asphalt, enamel, or similar materials are being heated or applied, the operation will conform fully with subsection 7.8 and paragraphs 7.1.1 and 7.3.1.

11.13.4 **Heating kettles.** Asphalt or tar kettles, when in use, shall not be left unattended and shall be placed on a firm, level base, and protected against overturning. Kettles shall have an effective lid or hood. They shall be equipped with an operable temperature indicating and limiting device that ensures the asphalt or tar temperature remains 50 degrees below the flashpoint. Kettles should not be used in confined or unventilated spaces, underground, in conduits, in or on enclosed buildings or structures.

11.13.5 **Fire protection.** A fire extinguisher, rated not less than 2-A:40-B:C shall be available at locations where heating devices or melting kettles are in use.

11.13.6 **Handling.** Adequate runways or accessways, clear of obstructions, shall be provided for employees carrying hot materials. Hot materials shall not be carried up or down ladders. Adequate hoisting devices shall be provided.

11.13.7 **Thinners.** Gasoline or similar volatile liquids shall not be used as thinners.

11.13.8 **Hand spraying.** The nozzle person applying hot tar asphalt shall not be permitted to work under hoses supplying the material to the spray nozzle. Flexible metallic hoses fitted with insulated handles shall be used in hand spraying operations.

11.13.9 **Housekeeping.** Distributors, retorts, hoses, and related equipment shall be kept reasonably free of accumulations of asphalt and tar.

11.14 LIQUIFIED PETROLEUM GAS

11.14.1 **Requirement.** Storage, handling, installation, and use of liquefied petroleum gases and systems shall be in accordance with NFPA 58 and 29 CFR 1926.153. Cylinders shall meet DOT specifications published in 49 CFR, Part 178, "Shipping Container Specifications."

11.14.2 **Hazardous locations.** Liquefied petroleum gas containers and equipment shall not be used in unventilated spaces, below grade in pits or trenches, below deck, or in confined areas where dangerous concentrations of gas may accumulate.

11.14.3 **Tubing.** Only tubing or piping approved for use in LPG systems shall be used. Aluminum or polyvinyl piping or tubing shall not be used.

11.14.4 **Hose.** Only hose labeled "LP-gas or LPG" shall be used. Hose shall have a minimum working pressure of 250 pounds per square inch.

11.14.5 **Valves and accessories.** Valves, fittings, and accessories connected directly to the container, including primary shutoff valves, shall have a minimum working gauge pressure of 250 pounds per square inch and shall be designed for LPG service.

11.14.6 **Shutoff valves.** Connections to containers, except safety relief connections, liquid level gauging devices, and plugged openings shall have a shutoff valve located as close to the container as possible. Shutoff valves shall not be installed between the safety relief device and the container, except where the arrangement of the shutoff valve is such that fully required capacity flow through the safety relief device is always possible.

11.14.7 **Safety relief valves.** Each container shall be equipped with one or more approved safety relief valves. These valves shall be installed to allow free venting to the outer air with the discharge not less than 5 feet horizontally away from any building opening. Container safety relief devices and regulator relief vents shall be located not less than 5 feet from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

11.14.8 **Dispensing**

a. *Portable containers.* Filling of portable containers from storage containers shall be performed outside and not less than 50 feet from the nearest building.

b. *Motor vehicles.* Filling of fuel containers on motor vehicles from bulk storage containers shall be performed not less than 10 feet from a masonry-walled building, and not less than 25 feet from any other building or structure.

c. *Refueling.* Equipment using LPG shall be shut down during refueling operations.

11.14.9 **Storage of cylinders and containers.** Storage of LPG containers and cylinders not in use shall be outside of buildings or structures, at not less than the following distances from the nearest building or combustible material storage.

<u>Quantity of LP-gas</u>	<u>Minimum distance</u>
500 lbs or less	0 foot
501 to 6,000 lbs	10 feet
6,001 to 10,000 lbs	20 feet
Over 10,000 lbs	25 feet

11.14.10 **Fire protection.** Storage locations shall be provided with at least one accessible portable fire extinguisher rated not less than 2-A:40-B:C, located not less than 25 feet nor more than 75 feet from the container.

11.14.11 **Temporary LPG heaters.** In addition to requirements in this subsection, temporary LPG heaters and equipment shall comply with paragraph 10.5.4.

11.15 PAINTS, VARNISHES, AND THINNERS

11.15.1 **Storage.** Paints, varnishes, lacquers, thinners, and other volatile paints or coatings shall be stored and dispensed in accordance with their flammability characteristics. Refer to subsection 11.12. Containers shall be tightly closed when not in use and not more than a 1-day supply shall be stored in buildings under construction.

11.15.2 **Ventilation.** Ventilation adequate to prevent the accumulation of flammable vapors in hazardous concentrations shall be provided in areas where paints and coatings are dispensed or applied. (Refer to subsec. 7.3.)

11.15.3 **Spray painting.** No smoking, open flame, exposed heating elements, or other sources of ignition shall be permitted in areas where flammable or combustible paints or coating are being sprayed. Spray painting booths and equipment shall be in accordance with NFPA 33, "Standard for Spray Application Using Flammable and Combustible Materials."

11.15.4 **Personal protective equipment.** Employees exposed to paints or coatings potentially hazardous to his/her health shall have exposure determinations made to document exposure and when appropriate shall be provided with and shall use appropriate protective equipment as set forth in section 8.

11.15.5 Electrostatic paint spraying

a. *Electrical.* Transformers, power packs, control apparatus, and other electrical portions of the equipment, with exception of the gun and its connection to the power supply, shall be located outside of the spraying area.

b. *Grounding.* The handle of the spray gun shall be effectively grounded by a conductive device to ensure the gun and the operator are at the same ground potential.

11.16 HOUSEKEEPING

11.16.1 **General.** Work areas and storage areas shall be kept free of accumulations of scrap material. Stairways, accessways, and scaffolds shall not be permitted to become obstructed by accumulation of scrap, supplies, materials, or equipment. Combustible materials including weeds and grass shall be removed before becoming a fire hazard.

11.16.2 **Lumber.** Scrap lumber shall be placed in containers and not be permitted to accumulate in work areas. Protruding nails shall be removed or bent over unless the scrap lumber is placed directly in containers for removal.

11.16.3 **Flammable or combustible liquids.** Spills of flammable or combustible liquids shall be promptly removed and safely disposed in accordance with hazardous waste regulations. Self-closing metal containers shall be provided for collection of rags and waste soiled by flammable or combustible liquids.

11.16.4 **Hazardous materials.** Waste materials hazardous to humans or animals shall be disposed of as required by the Government agency having jurisdiction.

11.16.5 **Burning.** Requirements governing the burning of waste or scrap are set forth in subsection 10.4.

11.16.6 **Tools and equipment.** Tools and portable equipment shall not be strewn about in a manner which may cause tripping or injury. Where a falling hazard exists, tools, materials, and equipment shall be adequately secured.

11.16.7 **Wind.** Loose or light materials shall not be stored or left on roofs or unenclosed height unless safely tied down or secured.

11.16.8 **Sacks and bags.** Empty bags having contained cement, lime, and other dust-producing material shall be removed from work area at least daily.

11.16.9 **Working aloft.** Containers shall be provided for storing or carrying rivets, bolts, drift pins, and similar items. Containers will be secured against accidental displacement.

11.16.10 **Excavated materials.** Roads and walkways shall be kept clear of excavated materials wherever possible. Where this is not possible, they shall be adequately posted and/or barricaded, and other access provided.

11.16.11 **Dropping material.** Waste material and debris shall not be dropped or thrown a vertical distance exceeding 6 feet unless:

- a. The area into which the material is dropped shall be completely enclosed with barricades not less than 6 feet back from the projected edge of the opening or level above. Signs warning of the hazard shall be posted at each level.

b. Safely designed chutes are installed providing protection for persons below. Chutes for debris and scrap shall be fully enclosed for their entire run except openings for insertion of materials. Such openings shall be equipped with covers or enclosures.

Section 12

ELECTRIC WIRING, GROUNDING AND BONDING

12.1 GENERAL

12.1.1 **Code requirement.** Electrical installations, temporary or permanent, shall comply with the applicable provisions of the National Electrical Safety Code, National Electrical Code, and applicable State codes, unless otherwise provided by regulations or this section.

12.1.2 **Approval required.** Electrical wire, conduit, apparatus, and equipment shall be approved or listed by the Underwriters Laboratories, Inc., or Factory Mutual Laboratories, for the specific application. Listed, labeled, or certified equipment shall be installed and used in accordance with the instructions included in the listing, labeling, or certification.

12.1.3 Protection of employees

a. *Proximity.* The employer shall not permit employees to work in such proximity to an electric circuit or within prescribed clearance distances that they may contact it in the course of their work, unless the employees are protected against electric shock by deenergizing the circuit and grounding it, or by guarding it by effective insulation or other means.

b. *Underground lines.* The employer will locate and sign all underground powerlines and facilities within the area. Unless otherwise required by the specifications, all underground lines installed will be protected by surface signs and a longitudinal warning tape buried 12 inches to 18 inches above the lines. No drilling, augering, or material excavating operation will be performed within 6 feet of underground lines unless the lines have been deenergized.

c. *Prior to work.* Prior to starting work in an area, a supervisor shall ascertain by inquiry, direct observation, or by instruments whether any part of an electric power circuit, exposed or concealed, is so located that the performance of the work may bring any person, tool, or machine into physical contact with the circuit or within prescribed clearance distances set forth in this section. (See subsec. 12.9.) Whenever possible, the circuit(s) shall be deenergized and grounded. Otherwise, the employer shall protect the employees by isolation, insulation, warning signs, or other methods commensurate with the hazard. The protection provided shall conform with national codes and this section. The employer shall advise the employees of the location of such lines, the hazard, and protective measures to be taken.

12.1.4 **Work qualification.** Work on electrical circuits and equipment shall be performed only by qualified personnel familiar with code requirements and experienced in the type of work assigned.

12.1.5 **Mechanical execution of work.** Electrical equipment and wiring shall be installed in a neat and workman-like manner. Unused openings in boxes, cabinets, equipment cases, or housings shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

12.1.6 **Protective equipment.** When it is necessary to work on energized lines and equipment rated at 440 volts or greater. Rubber gloves and other approved protective equipment or hot-line tools meeting the provision of ASTM standards shall be used.

12.1.7 **Working space.** Sufficient access and working space shall be provided and maintained around electrical equipment to permit ready and safe operation and maintenance of the equipment. Effective barriers or other means shall be provided to ensure that areas containing electrical circuits or equipment will not be used as passageways when energized lines or equipment are exposed.

12.1.8 **Live parts.** Live parts of wiring or equipment shall be effectively guarded to protect persons or objects from harmful contact. When fuses are installed or removed with one or both terminals energized, special tools insulated for the voltage shall be used.

12.1.9 **High-voltage equipment.** Transformer banks, open breakers, and similar exposed high-voltage equipment shall be isolated to prevent unauthorized access. Effective isolation shall consist of locked rooms, fence or screen enclosures, walls, or partitions, or elevated locations. Entrances to these isolated areas shall be kept locked when not under constant observation. **DANGER-HIGH VOLTAGE** warning signs shall be posted at entrances to these areas. Nonenergized conductive components, fences, handrails, screens, partitions, walls, and equipment frames shall be grounded and bonded in accordance with the National Electrical Code or National Electrical Safety Code.

12.1.10 **Work areas.** High-voltage electrical wiring passing through work areas shall be covered, barricaded, or elevated to protect it from contact by vehicular or foot traffic. Flexible cords shall be kept clear of working areas, walkways, and similar locations so as not to create a hazard to employees.

12.1.11 **Marking.** Electrical equipment shall not be used unless the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified is placed on the equipment and unless other markings are provided giving voltage, current, wattage, or other ratings as necessary. The markings shall be of sufficient durability to withstand the environment involved.

12.1.12 **Guarding of live parts.** Live parts of electrical equipment shall be guarded against accidental contact by enclosures or by location.

12.2 TEMPORARY WIRING

12.2.1 **Installation.** Temporary wiring shall meet all the requirements of the National Electrical Code, or applicable State or local code, except as specifically modified by the National Electric Code, or applicable State or local code. Temporary wiring used for feeders and branch circuits are permitted to be in multi-conductor cord or cable assemblies or open conductors, and shall be guarded, buried, or isolated by elevation to prevent accidental contact by personnel or equipment. Vertical clearance above walkways shall not be less than 10 feet for circuits rated 600 volts or less. All exposed temporary wiring shall be supported on insulators.

12.2.2 **Weatherproof.** Conductors used in tunnels, shafts, trenches, and wet or damp locations shall be of a type approved for the purpose as listed in Article 310 of the National Electric Code.

12.2.3 **Bushings.** Wiring installed in conduit shall be equipped with bushings at outlets and terminals.

12.2.4 **Receptacles.** All receptacles shall be of the grounding type, and shall be electrically connected to the equipment grounding conductor. Receptacles shall not be installed on branch circuits which supply lighting.

12.2.5 **Lighting strings.** Temporary lighting strings shall consist of nonconductive lamp sockets and connections permanently molded to the conductor insulation. Bulbs attached to festoon lighting strings and extension cords shall be protected by lamp guards. Broken or defective bulbs shall be promptly replaced. All lights used for illumination shall be protected from accidental contact or breakage. Metal-case sockets shall be grounded.

12.2.6 **Extension cords.** Extension cords shall be 3-wire grounded type, and shall be designated for hard service or extra hard service and shall be listed by the Underwriters Laboratories, Inc. The rated load shall not be exceeded. Cords shall be used only in continuous lengths without splice, except suitably molded or vulcanized splices may be used when suitably made with insulation equal to the cord being spliced and soldered or with wire connections or other type connections conforming to the National Electrical Code. Worn or frayed extension words shall not be used. Extension cords shall not be fastened with staples, hung from nails, or suspended by wire.

12.3 DISCONNECT AND OVERCURRENT PROTECTION

12.3.1 **Marking.** Switches, fuses, and automatic circuit breakers shall be plainly marked, labeled, or arranged to permit identification of circuits or equipment controlled by them.

12.3.2 **Switches.** Switches shall be of the enclosed safety type, with the enclosures grounded, and installed so as to minimize the possibility of accidental operation.

12.3.3 Lockout provision. Switches and breakers, rated 440 volts or greater, shall be provided with a means of locking in the OFF position. Also, fuse cabinets and circuit breaker cabinets shall be equipped with lockable doors.

12.3.4 Wet locations. Switches, circuit breakers, fuse panels, and motor controllers in wet or outside locations shall be enclosed in approved weatherproof cabinets or enclosures, installed so as to prevent moisture or water from entering or accumulating within the enclosure.

12.3.5 Shielding. Disconnecting means shall be either isolated or shielded to protect employees.

12.3.6 Incoming service. A readily accessible, manually operated switch shall be provided for each incoming service or supply circuit rated less than 5 kilovolts.

12.3.7 Overcurrent protection. Overcurrent protection shall be provided by fuses or circuit breakers for each feeder and branch circuit. Such protection shall adequately protect the circuit conductors and the load demanded. No overcurrent device shall be placed in any permanently grounded conductor, except where the overcurrent device simultaneously opens all conductors of the circuit.

12.4 GROUND-FAULT PROTECTION

12.4.1 Requirement. All 115-, 120-, and 220-volt, single-phase receptacle outlets used in locations such as laboratories, shops, garages, wet locations, outdoor receptacles, bathrooms, kitchens, and for construction operations shall be protected by a ground-fault circuit interrupter program.

12.4.2 GFCI (Ground-fault circuit interrupter) program. The ground-fault interrupter shall open the circuit on a ground current of 5 milliamperes or greater and shall be equipped with an integral pushbutton test circuit. The GFCI shall be installed in accordance with the manufacturer's instructions and shall be tested prior to initial use and periodically thereafter.

12.5 EQUIPMENT GROUNDING AND BONDING

12.5.1 Requirement. All wiring, electrical circuits, and equipment, except portable tools and appliances protected by a UL-approved system of double insulation, shall be effectively grounded in accordance with the latest edition of the National Electrical Code (NFPA 70), Article 250-Grounding.

12.5.2 Portable and plug connected equipment. The noncurrent-carrying metal parts of portable and/or plug connected equipment, not protected by a UL-approved system of double insulation, shall be grounded.

- a. Grounding shall be by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle to proper polarity.

12.5.3 Fixed equipment. Exposed, noncurrent-carrying metal parts of fixed electrical equipment, including motors, generators, frames and tracks of electrically operated cranes, electrically driven machinery, lighting standards, etc., shall be effectively grounded.

12.5.4 Portable and vehicle- or trailer-mounted generators. Under the following conditions, portable and vehicle- or trailer-mounted generators are not required to be provided with a driven ground. The employer shall have a competent person certify that portable and vehicle- or trailer-mounted generators meet these requirements prior to using the generator, or the generator shall be effectively grounded with a driven ground rod.

a. *Portable generators.* Under the following conditions, the frame of a portable generator shall not be required to be grounded and shall be permitted to serve as the grounding electrode for a system supplied by the generator if:

1. The generator supplies only equipment mounted on the generator and/or cord and plug connected equipment through receptacles mounted on the generator.
2. The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

b. *Vehicle- and trailer-mounted generators.* Under the following conditions, the frame of a vehicle or trailer shall be permitted to serve as the grounding electrode for a system supplied by a generator located on the vehicle or trailer if:

1. The frame of the generator is bonded to the frame of the vehicle or trailer.
2. The generator supplies only equipment located on the vehicle or trailer, and/or cord and plug-connected equipment through receptacles mounted on the vehicle, trailer, or on the generator.
3. The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

12.5.5 Effective grounds. The path from circuits, equipment, structures, and conduit or enclosures to ground shall be permanent and continuous, have ample carrying capacity for the current likely to be imposed on it, and have a resistance sufficiently low to permit sufficient current flow to operate circuit breakers and similar overcurrent devices in the circuit.

12.5.6 Ground resistance. Driven ground rod electrodes, where possible, shall have a resistance to ground not exceeding 25 ohms. When it is not possible to obtain a resistance of 25 ohms or less, two or more electrodes connected in parallel shall be used to obtain a resistance of 25 ohms or less. Ground resistance shall be tested upon installation and the record shall be available for review.

12.5.7 Testing grounds. Following installation, the grounding conductor shall be checked for size and continuity.

12.5.8 Bonding. Conductors used for bonding and grounding circuits and equipment shall be of sufficient size to safely carry the anticipated current. When attaching bonding and grounding clamps or clips, a secure and positive metal-to-metal contact shall be made. The ground end shall be attached first and the other end attached by using insulated tools or other suitable safety devices. When removing grounds, the grounding device shall be removed first from the conductor or equipment using insulated tools or other suitable safety devices. Such bonding and grounding attachments shall be made immediately after the circuit has been deenergized and before any work is started. Grounds shall not be removed until all work has been completed.

12.6 HAZARDOUS LOCATION

12.6.1 Requirement. Electrical wiring and equipment installed in hazardous locations, as defined in the National Electrical Code, shall conform to the respective standards set forth in the code. Further, all components and equipment used in hazardous locations shall be from among the equipment listed by a nationally recognized testing laboratory, such as Underwriters Laboratories, Inc., and Factory Mutual Engineering Corporation. Custom-made components and equipment certified by a registered electrical engineer proficient in the field are exempt from this requirement.

12.6.2 Installation. Equipment approved or listed for a specific hazardous location shall not be installed or intermixed with equipment approved for another hazardous location.

12.6.3 Maintenance. Wiring components and equipment shall be maintained as explosion-proof as contemplated in their respective approvals. There shall be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to tight conditions.

12.7 WET LOCATIONS

12.7.1 Requirement. Only the following type electrical systems are permissible for use in wet areas where there is danger of electrical shock:

- a. *Ground-fault interrupter.* Electrical circuits for lighting and handtools shall not exceed 120 volts and shall be protected by UL-listed ground-fault interrupters installed in conformance with the manufacturer's specifications.
- b. *Stationary portable equipment.* Stationary portable electrically powered equipment, such as pumps, heaters, blowers, welders, transformers, etc., shall be connected to a circuit protected by a ground-fault interrupter or shall be effectively grounded with both an internal grounding system and a visible flexible copper ground wire.

c. *Substitute equipment.* Whenever practical, air, battery, or hydraulically powered tools shall be substituted for electrically powered tools.

12.7.2 Receptacles. Receptacles and cord connectors used on damp or wet locations shall be designed for use in wet or damp locations, and unless approved for submersion shall not be allowed to lay in water.

12.8 BATTERY CHARGING

12.8.1 Requirement. Battery charging operation shall be restricted to well ventilated areas designated for that purpose. Signs with following wording will be posted at all entrances when explosive gases are produced: **"BATTERY ROOM - NO SMOKING OR OPEN FLAME WITHIN 25 FEET."**

12.8.2 Ventilation. Ventilation shall be adequate to ensure diffusion of the battery gases and prevent accumulation of an explosive mixture.

12.8.3 Nonseal type. Batteries of the nonseal type shall be located in enclosures with outside vents, or in well-ventilated rooms, so arranged to prevent the escape of fumes, gases, or electrolyte spray or liquid into other areas. Safety vent caps shall be kept in place during charging.

12.8.4 Racks and trays. Racks and trays shall be of sufficient strength and treated with an electrolyte resistive coating.

12.8.5 Housekeeping. Battery storage and charging areas shall be maintained free of combustible materials and scrap. Acid or corrosive spills shall be promptly cleaned up and safely disposed.

12.8.6 Protective equipment. Face shields, aprons, and rubber gloves shall be provided for employees handling acids or recharging batteries. (Refer to subsecs. 8.3 and 8.6.)

12.8.7 First aid. Facilities for quick emergency drenching of the eyes and body shall be provided within 25 feet of a battery charging area.

12.9 HIGH-VOLTAGE LINES

12.9.1 Requirement. Transmission and distribution lines installed at construction sites and rated at 600 volts or more shall be placed underground. Existing overhead lines shall be carried on towers or poles and provide clearances over roadways and structures in accordance with the more stringent requirements contained in the National Electrical Safety Code and this manual.

12.9.2 High-voltage line crossings (600 volts or over)

- a. *Requirement.* High-voltage overhead powerlines shall be considered energized unless the utility company or owner of the line has been notified, the line deenergized and grounded, and positive control measures taken to prevent energization of the line prior to completion of work.
- b. *Clearance.* No equipment or machinery shall be moved under energized overhead high-voltage lines unless the following clearances are maintained and any installed boom or mast is unloaded and lowered to transport position:

Normal voltage kV (phase to phase)	Minimum required clearance (ft)
0 to 0.75	4
Over 0.75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1,000	20

- c. *Posting.* All crossings where equipment or machinery will be moved under energized high-voltage line(s) shall be posted with signs meeting design specifications of section 9 for "**Danger**" signs. The signs will be located 50 feet from and on each side of the line(s), and shall be large enough to be readily readable from moving equipment. They will provide the following information:

1. Warning of the high-voltage line.
2. Line voltage.
3. Maximum height of equipment that shall pass under the line. (Maximum height of equipment shall be determined by subtracting the applicable clearance distance shown in "b" above from the actual line to ground distance during maximum sag conditions.)

12.9.4 Equipment operation adjacent to high-voltage lines (600 volts or over). The following requirements shall apply to the operation of equipment near or adjacent to high-voltage lines:

- a. *Requirement.* Operations near or adjacent to overhead high-voltage lines are prohibited unless one of the following conditions is satisfied:

1. The utility company or owner of the line has been notified, the line deenergized and grounded, and positive control measures taken to prevent energization of the line prior to completion of the work.
2. Equipment or any part thereof does not have the capability of coming within the following distances from the energized lines.

Table of minimum clearances (ft) for nominal system voltages (kV)

kV	ft	kV	ft
50 (or less)	10	161	14
69	12	230	16
115	13	345	20
138	14	500	25

Other kVs: use 10 ft plus 0.4 in/kv (over 50)

- b. *Exclusion.* Aerial lifts with insulated booms, certified for liveline barehanded maintenance, when used by qualified, trained personnel engaged in liveline barehand maintenance work shall be excluded.
- c. *Posting.* A notice of the minimum distances previously listed in subparagraph 12.9.3 shall be posted in the cabs of all cranes, shovels, backhoes, and related equipment having the capability of contacting high-voltage lines on the construction site.
- d. *Boom guards and proximity alarms.* Cage-type boom guards, insulating links, or proximity alarms may be used on cranes and related equipment. However, the installation and use of such devices do not satisfy the requirements set forth in subparagraph 12.9.3.

12.10 PORTABLE TRAILING CABLES AND TROLLEYS

12.10.1 **Requirement.** The installation and protection of trolleys and portable cables rated above 600 volts for supplying power to movable equipment, such as gantry cranes, mobile cranes, shovels, etc., shall conform to the National Electrical Safety Code standards.

12.10.2 **Armored or shielded conductors.** Conductors rated at 600 volts or more shall not be used as trailing cables unless they are heavy-duty armored or shielded. Such cables shall be moved only with nonconductive safety tongs; and when rated over 5,000 volts, only tested and approved hot sticks or gloves may be used.

12.11 TRANSMITTER TOWERS

12.11.1 **Requirement.** Prior to work near transmitter towers where an electrical charge may be induced in the equipment or materials being handled, the transmitter shall be shut down or a test shall be made to determine if induced current is a hazard. The following precautions shall be taken if it is determined that induced current is a potential hazard:

- a. *Grounds.* The equipment shall be effectively grounded to dissipate the induced current. On equipment with rotating boom, the grounds shall be attached to the structure supporting the boom.
- b. *Ground cables.* Grounding cables shall be attached to materials being handled by the hoisting equipment. They shall be placed and removed by the use of hot sticks of adequate capacity.

Section 13

WALKING AND WORKING SURFACES

13.1 **GENERAL.** Scaffolds, ladders, stairways, ramps, platforms, or temporary floors shall be provided for employees engaged in work that cannot be performed safely from the ground or from solid construction.

13.1.1 **Scaffolding.** Scaffolding shall be erected, dismantled, or altered under the supervision of a competent person and in compliance with the requirements of this section and ANSI A10.8, "Construction and Demolition Operations - Scaffolding - Safety Requirements," with the more stringent standards prevailing. Ladders or makeshift devices shall not be used to increase height of scaffolding. Scaffolding working surfaces shall be essentially level.

13.1.2 **Safety factors.** Scaffolds and their components, except for wire or fiber rope suspension, shall be capable of supporting at least four times the maximum intended load. Wire or fiber rope used for scaffold suspension shall be capable of supporting at least six times the maximum intended load.

13.1.3 **Access.** Access to scaffolding can be by separate or integral ladders or stairways meeting requirements of subsection 13.14 of this standard. Structural members will not be used for means of access.

13.1.4 **Nets, lifelines, lanyard, and belts.** Employees working on suspended or movable scaffolding or scaffolding without standard guardrails, shall be protected by nets, lifelines, lanyards, and belts as set forth in section 8.

13.1.5 **Guardrails.** Except for work platforms and scaffolds more than 6 feet above the ground or floor level shall be provided with standard guardrails, midrails, and toeboards on the open sides and ends except for floats, needle beam, and ladder-supported scaffolds. Scaffolds 4 to 6 feet in height, erected above machinery or other hazard, or having a minimum horizontal dimension in either direction less than 45 inches, shall also be provided with standard guardrails installed on open sides and ends. Guardrails are not required during the erection and dismantling of scaffolds. However, fall protection meeting the requirements of section 8, shall be used as required.

13.1.6 **Footing.** The footing or anchorage for scaffolds shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks shall not be used to support scaffolds or planks.

13.1.7 Poles, legs, uprights. Poles, legs, and uprights shall be plumb and securely and rigidly braced to prevent swaying and displacement.

13.1.8 Scaffold lumber. All load-carrying wood members of scaffold framing, except planks, shall be a minimum of number 1 southern pine, number 1 douglas fir, or the equivalent. All dimensions are nominal sizes as provided in the American Lumber standards except where rough sizes are noted. Only rough or undressed lumber of the size specified will satisfy minimum requirements.

13.1.9 Loadings. Scaffolds shall not be loaded in excess of the working load for which they are designed. Materials shall not be stored on scaffolds in excess of supplies needed for immediate operations. Manufacturer's scaffolds shall be used in accordance with manufacturer's recommendations.

13.1.10 Restrictions. Scaffolds shall not be altered or moved horizontally while being used or occupied except when specifically designed for such use. Free-standing scaffolds with a height to base ratio of more than 4 to 1 shall be guyed, braced, or otherwise restrained from tipping.

13.1.11 Design. Scaffolding that utilizes structural members and/or working surfaces different from those specified herein and in referenced standards shall be designed by a competent registered engineer and accepted by the COR or office head prior to onsite erection. The design of wood scaffolding members and connections, shall be in accordance with the "National Design Specifications for Wood Construction," published by the National Forest Products Association. Basic allowable stresses therein shall be multiplied by a factor of 0.065 to account for the additional safety factors for scaffolding, and a duration load adjustment of 1.25 shall be used. These section multiplication factors are cumulative.

13.2 SCAFFOLDING PLANKS

13.2.1 Requirement. Materials selected for scaffold working surfaces shall be designed to produce a platform that will safely support the specified load. The load rating for scaffold decking units shall be based on the greater of the person loading requirements or the uniformly distributed load requirement.

a. *Person loading requirements.* The design working load for scaffold decking units shall be calculated on the basis of one or more 200 pound persons with 50 pounds of equipment each. Scaffold decking units designed for one person shall be designed and constructed to carry 250 pounds placed in the center of the span. Scaffold decking units designed to support two people shall be designed to carry 500 pounds with 250 pounds placed 18 inches each side of the center of the span. Scaffold decking units designed to support three people shall be designed to support 250 pounds in the center of the span and 250 pounds 18 inches each side of the span.

b. *Uniformly distributed load requirement.* Each scaffold decking unit, where applicable, shall be designed to carry a uniformly distributed load as an alternate to the person loading requirement.

1. Light Duty	not permitted
2. Medium Duty	50 pounds per square foot
3. Heavy duty	75 pounds per square foot
4. Special Duty	greater than 75 pounds per square foot

c. Wood Scaffold Planks.

1. *Solid sawn wood scaffold planks.* Wood scaffold planks shall be designed so that the deflection, at the center of the span at the design load does not exceed the span divided by 60. All solid sawn scaffold planks shall be of a scaffold grade and shall be certified by or bear the grade stamp of a grading agency approved by the American Lumber Standards Committee. Permissible spans that comply with the above requirement are shown below.

Douglas Fir or Southern Pine, rough sawn	Spruce, rough sawn
2 x 10 in	1-7/8 x 9-7/8 in or 2 x 9 in

Loading Condition

One person or medium duty	10 ft	8 ft
Two people or heavy duty	8 ft	7 ft
Three People	5 ft	5 ft

Other combinations of planks and spans are permissible provided that all planks are grade stamped or certified as scaffold plank grade and the stresses and deflections do not exceed those specified in ANSI A10.8.

2. *Manufactured wood scaffold planks.* Wood scaffold planks other than solid sawn, shall bear the seal of an independent nationally-recognized inspection agency certifying compliance with the design criteria contained in ANSI A10.8.

3. *Fabricated scaffold planks and decks.* Fabricated scaffold planks and decks shall be marked to show the rated working load.

13.2.2 Width. The width of all scaffolds, ramps, runways, and platforms shall be sufficient to prevent congestion of persons, materials, or equipment, and in no case shall they be less than 18 inches wide.

13.2.3 Lapped planking. Planking, when lapped, shall overlap a minimum of 12 inches. Scaffold planks shall extend over their bearers not less than 6 inches nor more than 12 inches, or be cleated at both ends to prevent sliding off supports.

13.2.4 Flush planking. When installed flush, the butt joint shall be at the centerline of a pole and the plank ends shall be supported by and secured to separate bearers.

13.2.5 Corner planking. When a scaffold materially changes direction, the planks shall be laid and secured in a manner to prevent tipping. Diagonally installed bearers shall be used to support the intended loading and to prevent tipping.

13.2.6 Changing levels. When moving platforms or planking to another adjacent level, the old planking shall be left in place until the new bearers have been installed.

13.2.7 Working surfaces. All working levels on scaffolds shall be fully planked or decked. The planking units shall be placed as close together as possible. Where full planking cannot be obtained using standard width units, the open spaces between platform and guardrail shall not exceed 9-1/2 inches.

13.3 STANDARD GUARDRAILS

13.3.1 Design. A standard guardrail shall consist of a toprail, intermediate rail, toeboard, and posts. The vertical height of the guardrail shall be 42 inches.

13.3.2 Dimension. Wooden scaffold posts and toprails shall be a minimum 2- by 4-inch construction grade or equivalent lumber with posts spaced not to exceed 8 feet on centers. Intermediate rails shall be a minimum of 1 by 6 inches. Toeboards shall be a minimum height of 4 inches installed flush with the planking or floor.

13.3.3 Pipe guardrails. Posts, toprails, and intermediate rails shall be a minimum 1.5-inch-inside diameter steel pipe with posts spaced not to exceed 8 feet on centers.

13.3.4 Metal guardrails. Posts, toprails, and intermediate rails shall be 2-inch by 2- by 3/8-inch angle iron, or equivalent, with posts spaced not to exceed 8 feet on centers.

13.3.5 Guardrail strength. Regardless of material used, the guardrail shall be capable of withstanding a minimum loading of 200 pounds supplied in any direction at any point on the toprail with a minimum of deflection. Railings required to withstand greater stress due to the nature of use shall be designed with a minimum safety factor of four.

13.3.6 Rope guardrails. Synthetic or natural fiber ropes shall not be used as guardrails. Wire rope having equivalent strength of pipe guardrails may be used for top and intermediate rails provided deflection is less than 12 inches under a 200-pound loading at center span.

13.4 HAZARDOUS CONDITIONS

13.4.1 **Overhead protection.** Overhead protection shall be provided for employees working on scaffolds exposed to falling objects.

13.4.2 **Scaffold enclosures.** Where persons are required to work under scaffolding or the scaffold is above an accessway, the scaffold shall be enclosed on the open side and ends. Also, the space between the decking and the form or wall shall be enclosed. The protective enclosure shall be No. 18 U.S. Standard gauge wire, or equivalent, with 0.5 inch or less mesh.

13.4.3 **Welding, burning, and riveting.** Welding, burning, riveting, or open flame work shall not be performed on staging suspended by natural fiber or synthetic rope. Natural fiber or synthetic rope staging supports used in the proximity of corrosive materials shall be protected or treated to prevent deterioration.

13.4.4 **Hoisting equipment.** Material hoists shall not be mounted on scaffolds or elevated work platforms unless the scaffold or work platform is designed or strengthened to withstand the additional loading. Such design or strengthening shall be certified by a professional engineer.

13.4.5 **Prop-scaffolds.** The use of lean-to, and prop-scaffolds is prohibited.

13.5 SCAFFOLD MAINTENANCE

13.5.1 **Requirement.** Scaffold and work platforms, including access thereto, shall be routinely checked by competent personnel and maintained in safe condition. Scaffolding or elevated work platforms damaged or weakened in any manner shall be removed or repaired immediately. Employees shall not be permitted to work from weakened or damaged scaffolding.

13.5.2 **Unsafe conditions.** Scaffolds, platforms, and accessways shall be maintained free of ice, snow, grease, mud, and other materials or equipment which would create a slipping or falling hazard. Tools, materials, equipment, or debris shall not be permitted to accumulate on scaffolds, work platforms, or in accessways.

13.5.3 **Safe footing.** Where scaffolds, work platforms, or accessways are usually wet or slippery, an abrasive material shall be applied to improve footing.

13.6 WOOD POLE SCAFFOLDS

13.6.1 **Design.** Wood pole scaffolds exceeding 60 feet in height shall be designed by a professional engineer and constructed in accordance with the engineer's design specifications and drawings. Wood pole scaffolds 60 feet or less in height shall be constructed and erected in accordance with the specifications set forth in appendix K, tables K-1 through K-6 and figures K-1 and K-2. In addition, wood pole scaffolds shall conform to the general requirements in this section.

13.6.2 **Footings.** Scaffold poles shall bear on a foundation of sufficient size and strength to spread the load over an area sufficiently large to prevent settlement.

13.6.3 **Wood poles.** When wood poles are joined, they shall be spliced, the ends squared, and the members plumbed. Splice plates shall be used on at least two adjacent sides of the joint and shall be capable of developing strength in any direction equal to the spliced members.

13.6.4 **Independent pole scaffolds.** Independent pole scaffolds shall be set as close to the wall of the building or structure as possible. Cross bracing shall be set between the inner and outer sets of poles. (Refer to app. K.)

13.6.5 **Single pole scaffolds.** Single pole scaffolds shall be constructed and braced similar to the design illustrated in appendix K, figure K-1.

13.6.6 **Diagonal bracing.** Full diagonal bracing, as shown in appendix K, figures K-1 and K-2, shall be erected across the entire face of pole scaffolds in both directions. When it is necessary to splice the braces, it shall be done at the poles. The free ends of pole scaffolds shall be cross braced.

13.6.7 **Scaffold support.** All pole scaffolds shall be securely guyed or tied to the building or structure. Where the height or length exceeds 25 feet, the scaffold shall be secured at intervals not greater than 25 feet vertically and horizontally.

13.6.8 **Putlogs or bearers.** Putlogs or bearers shall be set with their greater dimension vertical. They shall project over the ledgers of the inner and outer rows of poles at least 3 inches. Every putlog or bearer on a single pole scaffold shall be reinforced with a 3/16-inch thick steel strip, or equivalent, over the entire length and width of its lower edge.

13.6.9 **Ledgers.** Ledgers shall be long enough to extend over two pole spaces and shall not be spliced between the poles. Ledgers shall be reinforced by bearing blocks securely nailed to the side of the pole to form a support for the ledger.

13.6.10 **Guardrails.** Standard guardrails and toeboards shall be installed on all pole scaffolds as set forth in paragraph 13.1.5.

13.7 OUTRIGGER SCAFFOLDS

13.7.1 **Design.** Outrigger scaffolds shall be constructed similar to the design illustrated in appendix K, figure K-3 and shall conform to the specific requirements of this subsection.

13.7.2 **Dimensions.** Single level outrigger scaffolds shall be constructed to conform with the minimum lumber dimensions and maximum spacing listed in table 13-1.

Table 13.1. - Minimum nominal size and maximum spacing

Component	Light duty-25 lb/ft	Medium duty-50 lb/ft
Outrigger size	2 by 10 in	3 by 10 in
Outrigger spacing	8 ft	6 ft
Planking	2 by 10 in	2 by 10 in

13.7.3 Outrigger beams

- a. *Lumber.* Outrigger support beams shall be straight-grained Douglas fir, or equivalent, free of knots.
- b. *Length.* The beams shall not extend more than 6 feet beyond the face of the building or structure, and the inboard end shall not be less than 1.5 times the outboard length measured from the fulcrum point.
- c. *Fulcrum point.* At the fulcrum point, the beam shall rest with sides plumb on a secure bearing at least 6 inches in each horizontal dimension. The beams shall be secured from movement or tipping at the fulcrum point.
- d. *Inboard ends.* The inboard ends of the beams shall be braced and secured to prevent tipping or movement in any direction.

13.7.4 **Planking.** Planking shall be laid flush, secured to the beams, and extend to within 3 inches of the wall of the building or structure.

13.7.5 **Guardrails.** Standard guardrails and toeboards shall be installed on all outrigger scaffolds.

13.7.6 **Multiple level.** When more than one level is to be supported by an outrigger system, the scaffold shall be designed by a licensed professional engineer.

13.8 SUSPENSION SCAFFOLDS

13.8.1 **General.** The following requirements apply to the construction and use of all types of suspension scaffolds listed in this subsection.

- a. *Design.* All parts and components of suspension scaffold systems, except the suspension ropes, shall be designed and constructed with a minimum safety factor of four.
- b. *Suspension.* Suspension scaffolds shall be supported by wire, synthetic, or fiber ropes with a minimum safety factor of six and secured to outrigger beams. Suspension ropes shall have the fixed ends equipped with a proper size thimble secured by splicing

or other equivalent means and attached to the supports by closed-type shackles. Running ends of the suspension ropes shall be securely attached to the hoisting drums, and at least four turns of the rope shall remain on the drum at all times. The suspension ropes shall be attached at the vertical centerline of the outrigger, and the attachment shall be directly over the hoisting drum.

c. *Outrigger beams.* Outrigger beams shall be structural steel, equivalent in strength to at least a standard 7-inch, 15.3-pound per foot steel I-beam, and shall be at least 15 feet long. Unless designed by a professional engineer for a specific use, they shall not extend more than 6.5 feet beyond the fulcrum or bearing point. The outrigger beams shall be set with their webs in the vertical position and anchored to the structure by the equivalent of U-bolts and anchor plates, washers, and nuts. The beams shall rest on wood bearing blocks; a stop bolt shall be installed on each end of every beam. When the inboard ends of the outrigger beams are stabilized by counterweights, the weight shall be securely fastened to the outrigger beam, and shall provide a safety factor of 4 to 1 against overturning. Counterweights shall be constructed of solid material.

d. *Hoisting devices.* All suspension scaffolds, except stationary or crane supported, shall be equipped with either manual or powered hoisting machines. The machines shall be either worm geared or powered both up and down, and designed to stop independently of manual braking and not move when the power is not being applied. Power units and manually operated winches shall be of a type tested and listed by Underwriters Laboratories, Inc., or Factory Mutual Engineering. Each hoist shall have a name plate stating:

- a. Manufacturer's name
- b. Maximum load rating
- c. Identification number
- d. Wire rope specification

e. *Hoist safety controls.* Controls for powered scaffolds shall be of the deadman type with a nonlocking switch or control. A device to shut off the power shall be installed ahead of the operating control. The speed control device shall be designed so that it cannot be manually released.

f. *Scaffold brackets.* Scaffold brackets shall be wrought iron or mild steel. Reinforcing steel shall not be used as part of the support system.

g. *Stability control.* Suspension scaffolds shall be controlled by wire rope guides or equivalent means such as taglines to prevent sway. Tiebacks of 3/4-inch manila rope, or equivalent, shall be installed on suspension scaffolds for use as a secondary means of anchorage.

h. *Ladder platforms.* Ladder platforms shall be designed and constructed in accordance with Appendix K. The type of lumber used in construction of the ladder assembly and platform shall be equivalent to:

<u>Use</u>	<u>Type</u>
Side stringers	Straight-grained spruce
Rungs	Straight-grained oak, ash, or hickory

The side stringers shall be tied together with tie rods passing through the stringers and riveted tight against washers on both ends. Flooring strips shall be spaced not more than 5/8 inch apart.

i. *Plank-type platforms.* Plank-type platforms shall be constructed of not less than nominal 2- by 10-inch unspliced scaffold planks, cleated together on the underside. Cleats shall be installed at not less than 4-foot intervals and within 6 inches of each end. The span between platform hangers shall not exceed 8 feet, and the planking shall not extend more than 12 inches past the end hangers. The platform shall be securely fastened to the hangers.

j. *Beam-type platforms.* Side stringers for beam-type platforms shall not be less than 2- by 6-inch nominal dimension, knot-free lumber set on edge. The flooring shall be supported on 2- by 6-inch cross beams, laid flat, and set snugly into the top edge of stringers at not less than 4-foot intervals. Flooring shall be 1- by 6-inch lumber nailed to the supports and not over 0.5 inch apart. The span between hangers shall not exceed 12 feet.

k. *Metal platforms.* Metal platforms shall be tested and listed according to Underwriters Laboratories, Inc., or Factory Mutual Engineering.

l. *Working loads.* Not more than two people at a time shall be permitted on a suspension scaffold designed for a working load of 500 pounds. Not more than three people at a time shall be permitted on a suspension scaffold designed for a working load of 750 pounds.

m. *Safety belts.* Employees using suspension scaffolds shall wear approved safety belts attached to a lifeline rigged independent of the scaffold system. The lifeline need not be used if the system has independent wire safety ropes installed at each end of the scaffold with approved grabbing and locking devices. However, each employee will be required to wear a safety belt attached to the scaffold. Belts and lifelines shall meet the requirements of subsection 8.8. Independent wire safety ropes with approved grabbers and locking devices shall be required whenever employee's safety belts are attached to the scaffold.

- n. *Overhead protection.* Overhead protection of 3/4-inch exterior plywood or equivalent strength material shall be erected not more than 9 feet above the decking when an overhead hazard exists.
- o. *Guardrails.* Suspension guardrails shall be equipped with standard guardrails and toeboards on the open side and ends. Patented-type guardrails affording equal protection may be substituted with approval of the COR.
- p. *Operation.* Suspended scaffolds shall only be operated by people who have been instructed in the operation, use, and inspection of the particular suspended scaffold to be used.
- q. *Testing and maintenance.* Suspension scaffolds shall be tested at twice the intended working load prior to use. Anchorage, rigging, and hoisting machines shall be inspected prior to the start of each shift. Scaffolds and hoisting machines shall be maintained in safe operable condition.

13.8.2 Two-point suspension scaffolds

- a. *Platforms.* Platforms of two-point suspension scaffolds shall be either ladder type, plank type, beam type, or metal type, constructed in conformance with paragraph 13.8.1. The platforms shall not be less than 20 inches nor greater than 36 inches wide overall. The platform shall be securely fastened to the hangers with U-bolts or other equivalent means.
- b. *Sheaves and blocks.* Sheaves of all blocks, consisting of at least one double and one single block, shall be as specified for the size and type of rope used.
- c. *Securing to building.* At each elevated work station, the scaffold shall be secured to the building or structure to prevent sway or movement away from the wall. Window cleaner's anchors shall not be used for this purpose.

13.8.3 Masons' adjustable multiple-point suspension scaffolds

- a. *Working load.* The scaffold shall be capable of supporting a working load of 50 pounds per square foot and shall not be overloaded.
- b. *Single outrigger beam.* Where a single outrigger beam is used, it shall have a minimum safety factor of four. The steel shackles or devices with which the suspension ropes are attached to the outrigger beams shall be placed directly over the hoist drums.
- c. *Guardrail.* Masons' suspension scaffolds shall be protected by standard guardrails and toeboards on open sides and ends.

13.8.4 **Stone setters' adjustable multiple-point suspension scaffolds .**

- a. *Loading.* The scaffold shall be capable of supporting a working load of 25 pounds per square foot and shall not be overloaded.
- b. *Platforms.* The platform shall be plank type, ladder type, beam type, or metal type securely fastened to the hangers.
- c. *Guardrails.* Stone setters' suspension scaffolds shall be protected by standard guardrails and toeboards on open sides and ends.
- d. *Multiple use.* When two or more scaffolds are used together, they shall not be bridged one to the other, but shall be maintained at the same height with platforms abutting closely.

13.8.5 **Single-point adjustable suspension scaffolds .**

- a. *Suspension.* The supporting cable shall be vertical over its entire length, and the basket shall not be swayed nor the cable attached to any intermediate point to change the original path of travel.
- b. *Multiple use.* The units may be combined to form a two-point suspension scaffold providing all requirements of paragraph 13.8.2 are met.
- c. *Guardrails.* Single-point suspension scaffolds shall be protected on all sides with a standard guardrail and toeboard, or equivalent.

13.9 **BOATSWAIN'S CHAIRS**

13.9.1 **Restrictions.** Boatswain's chairs shall not be suspended from cranes, derricks, or any type of motorized hoist without prior approval.

13.9.2 **Seat design.** The chair seat shall not be less than 12 by 24 inches and 1 inch thick. It shall be reinforced on the underside by cleats to prevent the seat from splitting.

13.9.3 **Seat slings.** The seat slings shall be either fiber rope with a minimum diameter of 5/8 of an inch, or wire rope at least 3/8 of an inch in diameter. The two slings shall be reeved through the four seat holes so as to cross each other on the bottom of the seat. Boatswain's chairs used for cutting, welding, or other heat-producing operations shall be constructed with wire rope slings.

13.9.4 **Safety belts.** Employees using boatswain's chairs shall be protected by safety belts and lifelines meeting the requirements of subsection 8.8.

13.10 METAL SCAFFOLDS AND TOWERS

13.10.1 **Requirement.** All metal scaffolds and towers shall be listed by Underwriters Laboratories, Inc., or Factory Mutual Engineering. Such scaffolds and towers shall be erected in accordance with the manufacturer's specifications and the design load limits shall not be exceeded.

13.10.2 **Access.** Metal scaffolds and towers shall be provided with access ladders or stairways conforming to subsection 13.14.

13.10.3 **Erection.** Sections of metal scaffolds shall be set plumb and securely connected together. All braces shall be installed prior to scaffold use. The entire scaffold shall be secured and braced to the building or structure at intervals not exceeding 30 feet horizontally and 26 feet vertically. Freestanding scaffold working platform heights shall not exceed three times the smallest base dimension.

13.10.4 **Platforms and planking.** Work platforms and planking shall be firmly secured at both ends to the bearers. Planks shall extend over their end supports not less than 6 inches nor more than 12 inches.

13.10.5 **Guardrails.** Metal scaffolds and towers shall be enclosed on open side and ends with standard guardrails and toeboards.

13.10.6 **Tube and coupler scaffolds**

a. *Design.* Tube and coupler scaffolds shall be designed and constructed to the specifications set forth in appendix K, table K-8 and in accordance with the requirements of this paragraph. Scaffolds exceeding the height limitations set forth in appendix K shall be designed by licensed professional engineers.

b. *Minimum dimensions.* The components of tube and coupler scaffolds shall be constructed of steel tubing not less than the respective minimum diameters and spacing indicated in the following table:

Table 13-2. Tube and component scaffold minimum dimensions

Component	Duty		
	Light	Medium	Heavy
Posts, runners, and bracing diameter	2-inch o.d.	2-inch o.d.	2-inch o.d.
Bearer diameter	2-inch o.d.	2.5-inch o.d.	2.5-inch o.d.
Max. post spacing (length)	10 feet	8 feet	6.5 feet
Max. post spacing (width)	6 feet	6 feet	6 feet

Note: Other spacing dimensions or other structural-type components, when used, shall be designed to support an equivalent load. No dissimilar metal shall be used on the same scaffold frame.

c. *Bearers.* Bearers shall be at least 4 inches, but not more than 12 inches longer than the post or runner spacing. Bearers shall be installed transversely between posts and shall be securely coupled to the posts bearing on the runner coupler.

d. *Diagonal bracing.* Diagonal bracing shall be installed across the scaffold at least every third set of posts horizontally and every fourth runner vertically. Longitudinal diagonal bracing shall be installed on the inner and outer rows of poles at an angle of 45 degrees from the base of the scaffold to the top. All diagonal bracing shall be attached to each pole that it crosses.

13.10.7 Tubular welded frame scaffolds

a. *Design.* Metal tubular frame scaffolds, including all load-bearing components, shall be designed and constructed to safely support four times the maximum rated load. The frames shall be placed one directly over the other using coupling or stacking pins to provide vertical alignment of the posts.

b. *Height limitation.* A licensed professional engineer shall prepare drawings and specifications for metal frame scaffolds exceeding 125 feet in height.

c. *Uplift.* When uplift may occur, frame members shall be locked together vertically by pins or equivalent means.

d. *Cross bracing.* Metal tubular frame scaffold shall be properly braced by cross bracing or diagonal braces, or both for securing vertical members together laterally,

and the cross braces shall be of such length as will automatically square and align vertical members. All brace connections shall be made secure.

13.10.8 **Mobile scaffolds.**

- a. *Maximum height.* The height of free-standing mobile scaffolds shall not exceed four times the minimum base dimension.
- b. *Casters.* Wheels and casters shall be equipped with a positive locking device to prevent accidental movement of the scaffold.
- c. *Moving.* The force necessary to move mobile scaffolds shall be applied as close to the base of the scaffold as possible. Provisions shall be made to stabilize the scaffold during movement. The scaffolds shall be used only on firm, level, and broom-clean surfaces.
- d. *Riding.* No persons shall be permitted to ride on a manually propelled mobile scaffold unless the following conditions exist:
 1. The floor or surface is within 1.5 degrees of level and free of pits, holes, or obstructions.
 2. The minimum dimensions of the scaffold base when ready to move is at least one-half the height.
 3. Outriggers, if used, shall be installed on both sides of staging.
 4. The wheels or casters are equipped with rubber or similar resilient tires.
 5. Tools and materials are removed from the platform or secured prior to movement.

13.11 **ELEVATING AND ROTATING WORK PLATFORMS**

13.11.1 **Requirement.** Elevating and rotating work platforms shall be designated and used in conformance with the standards set forth in ANSI A92.2, "Vehicle Mounted Elevating and Rotating Aerial Devices," and subsection 18.13 of this manual.

13.12 **FORM SCAFFOLDS**

13.12.1 **Design and construction.** Form scaffolds shall be designed and erected with a minimum safety factor of four, computed on the basis of the maximum rated load. Load-carrying wood members of the scaffold framing, planking, and guardrails shall comply with minimum requirements of paragraph 13.1.8. Lumber and steel used in the construction of

support brackets for form scaffolds shall conform to the dimensions set forth in this subsection for the specific type of scaffolding.

13.12.2 Scaffold planking. Planking used on form scaffolds shall comply with the requirements set forth in subsection 13.2.

13.12.3 Guardrails. Standard guardrails and toeboards meeting the requirements set forth in subsection 13.3 shall be installed on the open sides and ends of all form scaffolds exceeding 6 feet in height.

13.12.4 Figure-four form scaffolds.

a. *General.* Figure-four form scaffolds are intended for light duty and shall not be used to support loads exceeding 25 pounds per square inch unless specifically designed for greater loading.

b. *Design.* Figure-four form scaffolds shall be designed and constructed as illustrated in appendix K, figure K-4 incorporating the dimensions set forth in the following table.

Table 13-3. - Figure-four scaffold dimensions

<u>Component</u>	<u>Dimensions</u>
Upright and guardrail	2 x 4 inches minimum dimension
Upright or guardrail and ledger spacing	8 feet 0 inch maximum
Guardrail height	Approx. 42 inches
Outriggers or ledgers (two)	1 x 6 in minimum
Braces (two)	1 x 6 in minimum
Intermediate guardrail	1 x 6 in minimum
Max. ledger length	3 ft 6 in beyond form support member
Planking	2 x 10 inches minimum
Toeboards	4 inches minimum height

c. *Attachment to a form.* The form scaffold shall be an integral part of the form and nailed or bolted to the form studding as illustrated in appendix K.

13.12.5 Metal bracket form scaffolds.

a. *Design.* Metal bracket form scaffolds shall be designed and constructed with a minimum safety factor of four, computed on the basis of maximum rated load. The metal brackets may be of any metal which will support the maximum rated load and shall be constructed similar to the scaffold illustrated in appendix K, figure K-5. They shall be equipped with standard guardrails and toeboards.

b. *Attachment to form.* Metal brackets shall be spaced not more than 8 feet apart on centers. They may be an integral part of the form, in which case they shall be bolted or welded to the form, or they can be attached using "clip-on" or "hook-over" brackets, provided the form walers are bolted to the form or secured by snap ties or shea-bolts extending through the form and securely anchored.

c. *Folding-type brackets.* Folding-type brackets shall be either bolted or secured in the extended position with locking-type pins.

13.12.6 Wooden bracket form scaffolds.

a. *Design and construction.* The minimum design criteria set forth in this paragraph pertain to form scaffolding limited to light duty, and shall not be used to support loads exceeding 25 pounds per square foot unless specifically designed for greater loading. The scaffolds may be constructed of lumber or metal of equivalent strength, and shall be designed similar to the scaffold illustrated in appendix K, figure K-6.

b. *Minimum dimensions.* Minimum dimensions and spacing for wooden bracket form scaffolds shall be as set forth in the following table:

Table 13-4. - Minimum dimensions for wooden
bracket form scaffolds

<u>Component</u>	<u>Dimensions</u>
Uprights	2 x 4 in
Support ledgers	2 x 6 in
Bracing	1 x 6 in
Guardrails	2 x 4 in
Intermediate guardrail	1 x 6 in
Upright or bracket spacing	8 ft on centers (maximum)
Toeboards	4 in minimum height

c. *Scaffold width.* Scaffold width shall not be less than 2 feet nor greater than 3.5 feet, and the walkway shall be at least two scaffold planks wide.

13.13 LADDER SUPPORTED SCAFFOLDS.

13.13.1 **Requirement.** Only type 1A ladders may be used with ladder- supported scaffolds. The combined weight of workers, the planks, equipment, and materials shall not exceed the rated load capacity of the ladders.

13.13.2 **Height.** The maximum height of the working platform of ladder- supported scaffolds shall not exceed 20 feet. The maximum height of the working platform for ladder-

supported scaffolds not using ladder jacks shall not be more than 4 times the base width of the ladder unless the scaffold is guyed, tied off or braced, to prevent overturning.

13.13.3 **Securing.** Ladders used with ladder jack scaffolds shall be secured at top and bottom to prevent movement of the ladders.

13.13.4 **Scaffold planking.** Ladder-supported scaffolds erected with wood scaffold planks shall be limited to one person on the plank; when fabricated planks are used no more than two people are permitted on the plank.

13.13.5 **Ladder jacks.** Ladder jacks shall be so designed that they bear on the side rails in addition to the ladder rungs, or they shall bear on a minimum length of 10 inches on each rung.

13.13.6 **Safety belts.** Employees using ladder-supported scaffolds 6 feet or more above the ground or floor level shall be protected by safety belts and lifelines meeting the requirements of subsection 8.8.

13.14 **LADDERS**

13.14.1 **Requirement.** A stairway, ladder, ramp, or manhoist shall be provided at all personnel access points, where there is a change in elevation of 19 inches or more. At least one point of access between levels of buildings or structures shall be kept clear to permit free passage of employees at all times.

13.14.2 **Electrical hazard.** Portable metal ladders, and wood ladders with metal reinforcements shall not be used for any electrical work or permitted in substations, switchyards, powerplants, pumping plants, or in any area where contact can be made with energized circuits.

13.14.3 **Maintenance.** Provision shall be made for routine inspection and maintenance of all ladders. Broken or damaged ladders shall be promptly repaired or removed and destroyed.

13.14.4 **Securing ladders.** All ladders will be secured at the top and at the bottom and intermediate positions necessary to maintain them rigidly in place and to support the loads imposed upon them.

13.14.5 **Location.** Ladders shall not be placed in accessways or other locations where they may be displaced unless protected by barricades or guards. The area immediately adjacent to the top and bottom of a ladder shall be kept free of debris, materials, equipment, or other obstructions.

13.14.6 **Restrictions.** Ladders will not be used as work platforms or scaffolding or as structured members of scaffolds or work platforms or walkways. **Exception:** Portable

ladders may be used as a work platform when employees are using small handtools or handling light material.

13.14.7 **Use.** Employees will face ladders and keep hands free when ascending or descending ladders.

13.14.8 **Portable ladders.**

- a. The design, construction, use, and maintenance of portable ladders shall comply with the more stringent standards published in this subsection and ANSI A14.1, "Portable Wood Ladders," ANSI A14.2, "Portable Metal Ladders," and ANSI A14.5, "Portable Reinforced Plastic Ladders." Only type 1A extra heavy duty industrial ladders are acceptable.
- b. The slope or pitch (angle of inclination) shall not exceed 1 foot horizontal distance for each 4 feet of vertical rise; i.e., the minimum acute angle with the horizontal must not be less than 75 degrees.
- c. Portable stepladders shall not exceed 20 feet in height.
- d. Employees shall not work on ladders at heights exceeding 20 vertical feet from the ladder base.
- e. Portable ladders used for access in lieu of fixed ladders shall be secured against accidental displacement at the top and bottom. They shall extend a minimum of 42 inches above the upper landing. Stepladders shall not be used for this purpose.
- f. Portable ladders shall rest on a firm foundation capable of supporting the load without displacement in any direction.
- g. Extension sections of ladder shall not be used as independent ladders.
- h. Job-made ladders shall be tailored for intended use, but not used as portable ladders.
- i. Portable ladders are approved for one-man use only.
- j. Ladders shall be equipped with safety shoes, spurs, spikes, tread feet, or other approved slip-resistant devices at base section of each rail. The devices shall be designed to function at the specified angles of inclination and on the type of surface available.

13.14.9 **Fixed ladders**

- a. The design, construction, use, and maintenance of fixed ladders shall comply with the more stringent of standards published in this subsection and ANSI A14.3, "Safety

Requirements for Fixed Ladders," and ANSI A14.4, "Safety Requirements for Job-Made Ladders."

- b. Fixed ladders shall not have a length of climb over 24 feet unless equipped with a cage, well, or ladder safety device or offset landings at 20-foot intervals. Ladders equipped with cages or ladder safety devices shall have a maximum length of climb of 30 feet between ground, floors, or offset landings. Bottom of cages will start a minimum of 7 feet or maximum of 8 feet from the base of each section of ladder. Climbing devices will be installed so employee can attach or detach safety belt while standing on ground, floors, or platforms. Ladder widths will be increased to accommodate climbing devices. Reinforcing bar will not be used for rungs or grab rails on any fixed ladder.
- c. Provisions shall be made for a landing at the top of all fixed ladders by extending the side rails, stanchions, or other supports at least 42 inches above the landing.
- d. At least 7 inches toe space shall be provided from the centerline of the rung or step to the wall or other obstructions.
- e. Two separate ladders or double-cleat ladders shall be provided for access to and from work areas for 25 or more employees, or where simultaneous two-way traffic is necessary.
- f. See Appendix Q for basic design, construction, and installation criteria for single- and double-cleat job-made ladders.
- g. See Appendix O for basic design, construction, and installation criteria for fixed ladders and guardrails.

13.15 STAIRWAYS

13.15.1 Requirement. Temporary or permanent stairways shall be provided to work areas of buildings or structures 20 feet or more in height. This provision does not apply to access to work areas such as scaffolds and work platforms where it is established practice to use ladders. However, stairways shall be constructed for access to fixed scaffolds, walkways, and work platforms affixed to buildings and structures for access over extended periods of construction, or when employees routinely carry tools and materials.

13.15.2 Design. Stairways shall be designed and constructed with a live load safety factor of five but never less than a moving concentrated load of 1,000 pounds. They shall be installed at angles to the horizontal of between 30 and 50 degrees. Any uniform combination of rise/tread dimensions between 6-1/2- to 9-1/2-inch rise and 11- to 8-inch tread run can be used to obtain a stairway within this permissible range. No flight of stairs shall have an unbroken rise of more than 12 feet without a standard landing extending not less than 30 inches in direction of travel. Where doors or gates open directly on to the

stairway, a platform shall be provided, and the swing of the door or gate shall not reduce the width of the platform to less than 20 inches. Vertical clearance above any stair tread shall be at least 7 feet measured from the leading edge. (Refer to app. P.)

13.15.3 Construction. Temporary stairways and handrails shall be constructed of selected materials, free of imperfections and hazardous projections, and shall be rigidly supported. Stair treads shall be securely fastened in place.

13.15.4 Stair railings and handrails. Stairs having 4 or more risers, or rising more than 30 inches (whichever is less) shall be equipped with standard railings and standard handrails as specified in the following:

- a. Less than 44 inches wide and both sides enclosed: At least one handrail on right side descending.
- b. Less than 44 inches wide and one side open: One stair railing on the open side.
- c. Less than 44 inches wide and both sides open: A stair railing on each side.
- d. More than 44 inches but less than 88 inches wide: One handrail on each enclosed side and a stair railing on each open side.
- e. More than 88 inches wide: Same as subparagraph "d" above, plus a standard stair railing located midway of the width.

13.15.5 Standard stair railing. Standard stair railings shall be constructed to the specifications set forth for standard guardrails in subsection 13.3, "Standard Guardrails," except that no toeboard is required and the vertical height shall be not less than 36 inches, measured from top of the forward edge of the tread to the upper surface of the top rail. When the top edge of the stair rail system also serves as a handrail, the height of the top edge shall not be more than 37 inches or less than 36 inches.

13.15.6 Standard handrail. A standard handrail shall be securely mounted on the wall or partition, enclosing the stairs, and shall be no more than 36 inches, nor less than 30 inches in height. Material and strength requirements shall be equivalent to the stair railing and it shall be mounted at least 3 inches from the wall or partition. Handrails shall provide an adequate handhold for employees grasping them to avoid falling.

13.15.7 Projection hazard. The ends of stair rail systems and handrails shall be constructed so as not to constitute a projection hazard.

13.15.8 Metal pan stairs. Where permanent metal pan stairs are set for temporary use, treads of wood filler pieces shall be installed flush with the pan rims.

13.15.9 Stairwells and platforms. Stairwells and platforms shall be protected on all open sides with standard guardrails and toeboards.

13.15.10 Maintenance. Stairways shall be routinely maintained and debris and materials shall not be permitted to accumulate on stairs. Slippery conditions shall be eliminated as they occur.

13.16 RAMPS

13.16.1 Requirement. Temporary access ramps, designed in accordance with paragraph 13.16.2, may be substituted for stairways when the slope or incline does not exceed 15 degrees. Cleated ramps may, with prior approval, be used for access on slopes up to 20 degrees from the horizontal.

13.16.2 Design. Ramps shall be designed with a safety factor of five (5) with a minimum 100-pounds per square foot live load. Ramp width shall be sufficient to prevent congestion of persons, materials, or equipment but never less than 18 inches wide. Ramps shall be equipped with standard guardrails on open sides and with a minimum of one handrail. Cleated ramps (chicken walks) shall have 1- by 2-inch cleats spaced at equal intervals not exceeding 12 inches. Cleats shall be equal in length to the width of the ramp and secured with nails driven through the decking and clinched on the underside. Vehicle trestles, ramps, and bridges on which foot traffic is permitted shall be provided with a suitable walkway and guardrail outside of the roadway. Roadway ramps shall be protected with timbers or curbs not less than 8 inches high, secured to each side of the roadway.

13.16.3 Overhead protection. Overhead protection shall be provided as needed to protect the public, employees, or property from falling objects. The overhead protection shall be of sufficient strength to withstand the potential impact and shall be installed not less than 7 feet nor more than 9 feet above the ramp.

13.17 FLOOR AND ROOF OPENINGS

13.17.1 Requirement. Floor and roof openings, including skylights into which persons can fall, shall be covered with material and bracing of sufficient strength to support the load which may be imposed or they shall be protected by a securely anchored enclosure meeting the requirements of this subsection.

13.17.2 Protective enclosure. All uncovered floor or roof openings shall be enclosed on open sides with a standard guardrail and toeboard constructed as set forth in subsection 13.3, or covered by a cover capable of sustaining the load which may be imposed upon it, or a minimum of a 200 pound person

13.17.3 Stairway and ladderway openings. Stairway and ladderway floor openings shall be guarded by a standard guardrail and toeboard on exposed sides except the entrance.

Entrances to stairways or ladderways shall be offset or provided with a gate to prevent persons from walking directly into the opening.

13.17.4 Hatchways and chute openings. Hatchways and chute floor openings shall be guarded by one of the following:

- a. Hinged covers of sufficient strength to carry anticipated loads and a standard guardrail with one exposed or open side. When the hatchway or chute opening is not in use, the cover shall be closed or the exposed side guarded by a removable standard guardrail.
- b. A removable standard guardrail or self-closing gate installed on not more than one side, and fixed standard guardrails and toeboards on all other exposed sides. The removable guardrails shall be kept in place when the opening is not in use. Chute openings into which debris is manually dumped shall be guarded by a standard guardrail on the side which employees stand to dump debris.
- c. Removable standard guardrails, secured to the floor on all open or exposed sides, installed to permit removal of only a section or side(s) sufficiently large to perform the work. When the hatchway is not in use, the guardrail shall be immediately replaced and secured.

13.17.5 Doors and gates. Where doors or gates open directly on a stairway, a platform shall be provided and the swing of the door or gate shall not reduce the effective length of the platform to less than 20 inches.

13.18 WALL OPENINGS

13.18.1 Requirement. Wall openings, from which there is a drop of more than 4 feet where the bottom of the opening is less than 3 feet above the working surface, shall be guarded with a standard guardrail or guardrail components to afford protection to a height of 42 inches above the working surface. A standard toeboard shall be provided where the bottom of the wall opening is less than 4 inches above the working surface.

13.18.2 Extension platforms. Extension platforms, outside of wall openings, erected to provide access for materials, equipment, or personnel, shall be protected on exposed sides by a standard guardrail and toeboard.

13.19 OPEN FLOORS, AND PLATFORMS

13.19.1 Requirement. The perimeters of all floors, platforms, etc., 6 feet or more above adjacent floor or ground level, shall be guarded by the installation of standard guardrails, or equivalent guarding unless or until they are permanently enclosed to a height of 3 feet or more above the floor or working surface. Standard toeboards shall be provided when there is a hazard to persons or property from falling objects.

13.19.2 Hazardous locations. In locations where a hazardous condition exists, such as projecting reinforcing steel, moving equipment, or hazardous materials, standard guardrails shall be provided regardless of height.

13.19.3 Protection from falling objects. When employees are required to work under an open-sided wall opening or platform where a hazard from falling objects exists, the contractor shall install appropriate and effective protection such as enclosed guardrails or nets as described in subsections 13.3 and 8.10, respectively.

13.19.4 Removal of guardrails. The guardrails shall only be removed concurrent with the erection of the permanent wall, and the openings kept as small as possible considering the nature of the work and the safety of the employees.

13.20 ROOFING PROTECTION

13.20.1 Requirement. During construction, demolition, or repair and maintenance of roofs, adequate protection shall be provided for employees working on or under the roof. Fall protection will be required whenever the employees are subject to possible falls from heights exceeding 6 feet from the adjoining level(s). Employees engaged in roofing activities where eave to ground distances are 6 feet or greater shall also be subjected to these requirements when:

- a. Working within 10 feet of any part of the roof perimeter.
- b. Working anywhere on roofs with slopes of 1:3 or greater.

Fall protection will be one or a combination of the following types:

- a. Lifelines, safety belts, and lanyards meeting subsection 8.8.
- b. Standard guardrails meeting requirements of subsection 13.3.
- c. Safety nets meeting requirements of subsection 8.10.
- d. Catch platform.
- e. Use of a warning line system supplemented by the use of a safety monitoring system are acceptable on flat roof only. This option is acceptable only on roofs with slope flatter than 1:3.

Overhead protection will be required for all employees working under the roof. Overhead protection can be provided by use of temporary decking, suspended platforms, nets, or other equivalent devices.

13.20.2 Warning line system. Warning lines shall be erected around all open sides of the work area. When mechanical equipment is not being used, the warning lines shall be erected not less than 6 feet from the roof edge or opening. When mechanical equipment is being used, the warning line shall be erected not less than 6 feet from the roof edge or opening, which is parallel to the direction of mechanical equipment operation, and not less than 10 feet from the roof edge or opening, which is perpendicular to the direction of mechanical equipment operation. Work outside warning lines is prohibited without fall protection. Work outside the warning line requires positive fall protection.

- a. The warning lines shall consist of rope, wire, or chain, with a minimum breaking strength of 500 pounds, attached to supporting stanchions. The warning line shall be marked with high visibility material at a maximum of 6-foot intervals. The warning line shall be rigged so that at its lowest point it is no less than 34 inches from the roof surface, and at its highest point it is no more than 39 inches.
- b. After erection, the warning lines and stanchions shall be capable of supporting a minimum force of 16 pounds applied from any direction.
- c. *Safety monitor.* When a warning line system is used, it shall be supplemented by a safety monitoring system. A competent person shall be assigned to be the safety monitor and shall monitor the safety of all employees working on the roof. The safety monitor shall warn employees when it appears that they are unaware of the hazard or are acting in an unsafe manner. The safety monitor must be on the same roof as the employees, and within visual sight distance of the employees, and must be close enough to verbally communicate with them. The safety monitor shall not be performing any other work.

13.20.3 Material handling. On roofs over 16 feet in height, a hoisting device, stairway, or progressive platform shall be installed for use in supplying material and equipment. Level landing platforms with guardrails and toeboards shall be provided at the roof level.

- a. Roof edge materials handling areas and materials storage. When guardrails are used at hoisting areas, bitumen pipe outlet areas, and roof edge storage areas, a minimum of 4 feet of guardrail shall be erected on each side of the area.
 1. A chain or gate shall be placed across the opening between the guardrail sections when materials handling operations are not being performed.
 2. Employees working in the area when the guardrail is open shall be protected by a safety belt and lanyard system. The safety belt system shall be rigged to allow the movement of the employees only as far as the edge of the roof.

13.20.4 Crawling boards (chicken ladders). Crawling boards can be used to assist personnel in ascending or descending steep roofs. Crawling boards shall not be less than 10 inches wide and 1 inch thick, with 1- by 1.5-inch cleats spaced at equal intervals not

exceeding 24 inches. The cleats shall be equal in length to the width of the crawl board and secured with nails driven through the crawl board and clinched on the underside. The crawling board shall extend from the ridge pole to the eaves. A securely fastened lifeline of at least 3/4-inch manila rope or equivalent shall be strung beside each crawl board.

13.20.5 Roofing brackets. Roofing brackets shall be secured in place by nailing in addition to the use of metal projections. When it is impractical to nail the brackets, rope supports consisting of 3/4-inch manila rope or equivalent shall be used.

13.20.6 Training. A training program shall be implemented for all employees working on a roof so that they are able to recognize and deal with the hazards of falling associated with working near a roof perimeter or roof opening. The training shall cover the following:

- a. The nature of the fall hazards.
- b. The function, use, and operation of the fall protection systems, warning line system, and safety monitoring systems being used.
- c. The role of each employee in the safety monitoring system when this system is being used.
- d. The correct procedures for the handling and storage of equipment and materials.

13.21 CRANE SUPPORTED PERSONNEL PLATFORMS (MANSKIPS)

13.21.1 General requirements. The use of crane-supported personnel platforms is prohibited except when the erection, use, and dismantling of conventional means of reaching the worksite, such as personnel hoists, ladders, stairways, aerial lifts, elevating work platforms, or scaffolding, would be more hazardous or is not possible. They shall only be used when specifically authorized, and only in accordance with this subsection. Requests for authorization to use crane-supported personnel platforms must be in writing. The request must (1) detail the exact operation to be performed with supporting data as to why it cannot be safely accomplished using other standard procedures, and (2) confirm, with sufficient manufacturing and design engineering data, that the proposed system and equipment are in full compliance with the requirements contained herein. Approvals will be for the specific operation described and the platform system will not be used in any other operation until an additional request has been submitted and approved. Approved systems will not be placed into operation until a JHA conforming to subsection 3.5 has been developed. The JHA shall contain provisions for initially and periodically instructing the crane operator and all affected employees. Further, personnel will not work from crane-supported scaffolding except when under constant supervision of a general foreman or superintendent and the crane and operator meet the requirements of this subsection and paragraphs 18.1.4, 18.1.5, and 18.1.6.

13.21.2 Specific requirement

a. *Hoist-line suspended personnel platforms.* No platform shall be suspended from boom extension, auxiliary boom noses, jibs, swingway fly sections, butt sections, or luffing jibs. Suspension of a platform from other than the main boom nose is strictly prohibited. Handling personnel above ground is prohibited when wind velocity exceeds 10 miles per hour (16.1 kmh) or upon indication of any other dangerous weather condition or impending danger. Cranes shall be level during operation and outriggers fully extended and jack pads set on firm level terrain or on substantial shoring at all times. Cranes used in platform operation will not be located so any part thereof has the capability of coming within the minimum distance from energized lines set forth in paragraph 12.9.3. Use of barriers, manufacturer's locks, or control lever restraints to meet these requirements is prohibited. Materials shall not be handled or lifts performed when personnel are occupying the platform. The crane will not be rigged for material handling while platform is attached. Belting off or otherwise attaching a platform to an adjacent pole, structure, or equipment is prohibited. Lifting and lowering speeds shall not exceed 100 feet (30.48 meters) per minute. Load and boom hoist drum brakes, swing brakes and locking devices, such as pawls or dogs, shall be engaged when the occupied personnel platform is in a stationary position. Employees occupying platforms shall wear a body belt with lanyards appropriately attached to the load block or fall ball or to a structural member of the platform. Belts, lanyards, and structural support members will meet requirements contained in section 8. Hoisting of employees while the crane is traveling is prohibited. Employees shall keep all parts of bodies inside platform during raising, lowering, and positioning.

b. *Boom-mounted personnel platforms.* No personnel platform will be mounted on a crane boom unless in conformance with the more stringent of these or manufacturer's requirements. Platforms and cranes shall be designed, constructed, and operated in conformance with the current edition of ANSI A92.2, "Vehicle Mounted Elevating and Rotating Aerial Devices," or shall be designed and certified by the manufacturer or qualified competent engineer for personnel platform work. All crane operations other than those associated with travel will be controlled from the platform with an overriding crane control feature. The crane and platform shall meet design safety factors and be operated in accordance with appropriate restriction and requirements defined in "a" above and elsewhere in this subsection.

c. *Crane.*

1. The crane shall be inspected and tested in accordance with paragraphs 18.1.4 and 18.1.5.
2. The crane shall be equipped with planetary or worm gears, torque converters, automatic braking systems, or other equivalent systems that prevent the boom hoist and loadlines from being placed in a freewheeling or neutral position

controlled by manual brake and/or dogs only. Only the "main" hoist shall be used for personnel handling.

3. The crane shall be capable of sustaining a static load of two times the rated platform capacity (as determined by the crane's capacity chart) for all radius and configuration through which the platform will be hoisted.
4. The minimum load hoist line wire rope safety factor shall be 7, except that where rotation resistant rope is used, the factor shall be 10.
5. An anti-two-blocking device or two-block damage prevention feature shall be installed and operating. The anti-two blocking device shall have automatic capabilities for controlling functions that may cause two-blocking conditions.
6. Telescoping booms shall be marked or equipped with a device to clearly indicate at all times the boom's extended length to the operator.
7. All critical components of hydraulic or pneumatic systems shall have a minimum bursting strength of at least four times normal operating pressure for which the system is designed. (Critical components are those in which a failure would likely result in free rotation or lowering of the boom or platform.)
8. All critical hydraulic cylinders shall be equipped with pilot-operated check valve or other appropriate devices to prevent free-fall or uncontrolled movement of boom or platform in the event of hydraulic line failure. Electrical systems used for positioning the platform will provide equal protection in the event of power failure.
9. The crane shall be level within 1 percent, and located on firm footing. The out riggers shall be extended and engaged.

d. *Platforms.*

1. The personnel platform shall be designed by the crane manufacturer or a qualified engineer competent in structural design.
2. Suspension systems shall be designed to minimize tipping of the platform due to movement of employees occupying the platform.
3. The entire platform shall be designed with a minimum safety factor of five.
4. Six-foot minimum headroom shall be provided for employees occupying the platform.

5. Each personnel platform shall be provided with perimeter protection from the floor to 42 inches \pm 3 inches above the floor, which shall consist of either solid construction or expanded metal having openings no greater than one-half of an inch.
6. A grab rail shall be provided inside the personnel platform.
7. An access gate, if provided, shall swing inward and shall be equipped with restraining device to prevent accidental opening.
8. Overhead protection shall be provided on the personnel platform when employees are exposed to falling objects.
9. All rough edges exposed to contact by employees occupying the platform shall be ground smooth.
10. All welding shall be performed by a welder qualified for the weld grades, types, and material specified in the design.
11. The personnel platform shall be conspicuously posted with a plate or other permanent marking indicating the personnel platform weight and the rated load capacity of the personnel platform.
12. Personnel platforms shall be easily identifiable by color or marking and shall only be used to hoist personnel and approved tools and equipment.
13. When a wire rope bridle is used to connect the personnel platform to the loadline, the bridle legs shall be connected to a single ring or shackle.
14. Hooks or fall ball assemblies, lower load blocks, or other attachment assemblies shall be of a type that can be closed and locked, eliminating the hook throat opening. Alternatively, a shackle with a screw pin, nut, and retaining pin may be used.
15. Wire rope, shackles, rings, and other rigging hardware shall have a minimum safety factor of seven.

e. *Additional inspections and tests.*

1. Cranes which are used to hoist personnel platforms shall be inspected by a competent person at the beginning of each shift and/or prior to hoisting employees on the personnel platforms after the crane has been used for any material-handling operations.

2. A full-cycle operational test lift at 150 percent of the intended load of the personnel platform shall be made prior to hoisting of employees for the first time at each new setup location.

Note: Setup location means the location to which the crane or derrick is brought and set up, including assembly and leveling.

3. A trial lift with the personnel platform unoccupied shall be made at the beginning of each shift and after the crane has been used for hoisting materials to ensure that all systems, controls, and safety devices are functioning properly.

4. A visual inspection of the crane, personnel platform, and base support shall be conducted immediately after lift testing in order to determine whether the testing has produced any adverse effect upon any component or structure.

5. Any defects found during such inspections which may create a safety hazard shall be corrected before further use.

f. *Work practices.*

1. The crane operator shall remain at the controls at all times when the personnel platform is raised.

2. Employees being hoisted shall remain in direct communication with the crane operator at all times.

3. A prelift meeting shall be held prior to lifting personnel at each work location. The prelift meeting shall be attended by the crane operator, employees involved, and the responsible general foreman or superintendent.

Section 14

O&M (OPERATION AND MAINTENANCE) ACTIVITIES

14.1 **PURPOSE.** The purpose of this section is to promote safe work practices and healthful working conditions for all employees engaged in O&M activities administered by Reclamation. The provisions and standards set forth herein provide requirements specific to O&M activities and facilities.

14.2 SCOPE

14.2.1 **Application.** These standards apply to all Reclamation O&M personnel and, where applicable, to contract personnel performing operation and maintenance of power, water, and land activities.

14.3 CLEARANCE PROCEDURES

14.3.1 **General.** A Clearance is a process used to establish, under tightly controlled discipline, a safe environment within which workers can perform their assigned tasks on equipment or facilities. A lockout/tagout program, as required in section 15, shall be used to control all other hazardous energy sources. It includes the actions of systematically isolating the equipment from all sources of hazardous energy (electrical, mechanical, pneumatic, hydraulic, and chemical) and attaching lockout/tagout devices to the operating and control points for these sources of energy. It also includes a written statement with documentation (switching program) declaring that the equipment to be worked on has been deenergized and isolated from hazardous sources of energy. A Clearance is "issued" when the necessary actions including documentation have been accomplished and a statement to that effect is given to the person receiving the Clearance by the Operations Supervisor. A Clearance is "released" when the person holding the Clearance releases the Clearance which was issued. For a full, detailed description of safe Clearance procedures see FIST Volume 1-1, Section 7, "Clearances."

Procedures for entry into confined spaces are described in subsection 7.8.

14.3.2 **Requirement.** No work requiring a Clearance shall be performed until all procedures established by FIST Volume 1-1, the energy control procedures developed under subsection 15.2.4, and the specific hazardous energy control procedures developed by the Project/facility have been implemented.

A SAFETY TAG, DANGER TAG, OR HOT LINE ORDER TAG SHALL BE CONSIDERED THE SAME AS A LOCK, AND THE TAGGED POINT SHALL NOT BE OPERATED WHILE THE SAFETY TAG IS IN PLACE.

14.4 WATER PASSAGE CLEARANCE PRACTICES

14.4.1 General. Personnel shall not be allowed into a water passage until a proper Clearance has been issued. Before personnel enter water passages, such as penstocks, turbines, scrollcases, draft tubes, water conduits, stilling basins, canal structures, gates, and other sources of water shall be isolated by closing all appropriate gates, valves, and bypass valves, and these devices shall be made inoperable, in accordance with subsection 15.3. All associated drain valves, manhole covers, etc., shall be considered in the Clearance. Additional precautions may be necessary to prevent other parallel drain flows from entering the passageway through the open drain valves.

14.4.2 Hydraulically operated valves. Personnel shall not be allowed into a waterway until the proper Clearance has been issued. Hydraulically operated valves shall be made inoperable in conformance with lockout/tagout procedures contained in subsection 15.3 and FIST Volume 1-1. This requirement can be accomplished by closing and disabling shutoff valves, installing blind flanges, or mechanically blocking the valve operation.

Valves that are to remain in the open position for entry into the waterway, for valve seat inspection, ventilation, etc., shall be disabled as above. The valve leaf shall be mechanically blocked open with adequate support to prevent movement.

14.5 LOCKOUT/TAGOUT (Not Under a Clearance)

14.5.1 General. O&M workers frequently perform inspection, maintenance, and lubrication operations in locations that present the potential for injury from inadvertent or unexpected activation of equipment or machinery. These locations shall have the equipment or machinery being worked on, isolated from all hazardous energy sources in accordance with section 15.

14.5.2 Requirement. A positive lockout/tagout program shall be used to protect personnel from inadvertent or unexpected activation of equipment or machinery. Control of hazardous energy and application of locking and tagging devices shall be in accordance with section 15.

See appendix E, figures E-2 and E-3, for illustrations of locking and tagging procedures.

14.6 GROUNDING REQUIREMENTS.

14.6.1 General. Grounding requirements are divided into two basic categories: (1) personal protective grounds and (2) equipment grounds.

14.6.2 Personal protective grounds. Any electrical circuit or equipment, except electronic circuitry or equipment, normally operated in excess of 600 volts, shall be treated as energized until it is disconnected from all normal sources of electrical energy, a Clearance is properly established (as defined in para. 14.10.1 and Facilities, Instructions, Standards, and Techniques (FIST) Volume 1-1, subsec. 7.1) and it is properly grounded. If possible, the grounds shall be placed within sight of the workers. The job supervisor or employee holding the Clearance shall

be personally responsible for ensuring that these protective grounds are placed and removed in accordance with applicable safety standards. FIST Volume 5-1, "Personal Protective Grounding," provides the necessary information on equipment and procedures and shall be used to accomplish the grounding required.

a. Personal protective grounds must be capable of conducting the maximum fault current that could occur if a supposedly deenergized line or equipment is, or becomes, energized. A basic requirement in assessing the capability of protective grounds to conduct fault current is the determination of the maximum fault current and fault clearing time for each powerplant, substation, and transmission line in the system. Protective grounding cables can then be sized in accordance with the instructions in FIST Volume 5-1. The minimum size of ground cable shall have an ampacity greater than No. 2 AWG copper, or the equivalent. Grounding rods must be at least 5/8-inch diameter steel or iron rods, 1/2-inch diameter copper-clad steel, or 3/4-inch diameter galvanized pipe. They shall be in unbroken 8-foot lengths and driven to full depth. Resistance to ground shall not exceed 25 ohms.

b. When two or more crews are working on the same line or apparatus at the same location, the designated lead supervisor shall be responsible for securing the Clearance in accordance with FIST Volume 1-1 and for the installation and maintenance of adequate protective grounding. All crews shall work under the same grounds. If there is a change of lead supervisor at the jobsite, the responsibility for the protective grounds shall be transferred from the first lead supervisor to the second when the first lead supervisor releases his Clearance.

Work by two or more crew on the same line at different locations is prohibited.

14.6.3 Equipment grounds. The requirement for equipment grounds are given in subsection 12.5.

14.6.4 Application of protective grounds. Conductors and electrical apparatus shall be treated as energized, except when they are properly grounded. Circuits thought to be deenergized shall be tested with a hot stick, "noisy tester," "hot horn," or similar device suitable for the rated voltage of the circuit, to ensure that circuit is actually deenergized.

Procedures for installing the grounds on transmission line structures and in substations, switchyards, and powerplants are given in FIST Volume 5-1.

Care, inspection, and testing of protective grounding equipment shall be performed as described in FIST Volume 5-1.

14.7 POWERPLANTS, SUBSTATIONS, PUMPING PLANTS, AND WATERWAYS

14.7.1 **Clearances.** The requirements of section 15, "Control of Hazardous Energy", and FIST Volume 1-1, "Hazardous Energy Control Program" shall be followed to protect workers from the hazards of inadvertent or premature energizing or activation of systems or equipment.

14.7.2 **Communications.** A JHA shall be conducted for each activity. If the activity requires an employee to work alone or in remote locations, the analysis shall include provisions for summoning and obtaining assistance in an emergency.

14.7.3 **Unattended stations.** Employees or crew supervisors entering unattended stations shall notify the dispatcher/operator of their arrival and departure, the purpose, and expected duration of the visit. The employee or supervisor shall also make an entry in the station logbook stating the date, time, and purpose of their visit.

14.7.4 **Absence from station.** When only one employee is on duty at a facility, this employee shall notify the control center before leaving the normal work location, stating the purpose and estimated duration of the expected absence. Upon return, the employee shall notify the control center.

14.7.5 **Working on pressurized equipment.** After proper isolation and before removing a valve bonnet, breaking a flanged joint, or opening other pressure connections (including manhole covers), the bolts, nuts, or other fasteners shall be loosened just enough to ensure that pressure does not exist.

14.7.6 **Turbine pits.** In turbine pits, employees shall not stand on or between wicket gate arms and links unless a proper, safe Clearance has been obtained. When cleaning and greasing this equipment and placing or removing blocks on servomotor piston rods, care must be exercised to keep hands and fingers in the clear. When possible, a positive blocking system shall be installed.

14.7.7 **CO₂ systems.** The air housing of a generator, motor, or other enclosure protected with an automatic CO₂ system shall not be entered for any reason unless the CO₂ system has been electrically and mechanically deactivated and locked and tagged out.

14.7.8 **Oil-filtering operations for insulating and lubricating oils.** During oil-filtering operations, the following precautions shall be observed:

a. *Grounding.* Protective grounding and bonding shall be placed as specified in subsection 12.5.

b. *Energized equipment.* Oil shall not be filtered in energized equipment. This rule shall not apply to permanently installed oil-filtering equipment for reactor or capacitor breakers.

- c. *Fire protection.* Properly charged fire extinguishers rated 2-A:40-B:C shall be maintained no closer than 10 feet nor further than 50 feet from the work during these operations.
- d. *No smoking.* Smoking or open flames is prohibited within 25 feet of oil-filtering operations.
- e. *Oil-filtering vans.* The floor or deck of oil-filtering vans shall be made of nonskid material or treated to provide a nonskid surface. Suitable steps and grab handles shall be provided for safe access from ground level.

14.8 ENTERING CONFINED SPACES

14.8.1 **Criteria for entrance.** Examples of confined spaces are transformer or circuit breaker tank, tank car, governor tank, sump, pipeline, scrollcase, penstock, pipeline, and water tank. Requirements for entrance into these spaces are found in subsection 7.8.

14.9 ELECTRICAL SAFETY

14.9.1 **Circuits above 600 V.** Work on circuits above 600 volts shall be performed only by trained and experienced personnel.

14.9.2 **Work near energized equipment.** When maintenance or construction work is to be performed near energized high-voltage (600 volts and above) equipment, workers shall be warned of adjacent energized equipment. Situations that constitute a hazard shall be identified by one of the following means:

- a. *Barricades.* Equipment that may be hazardous to workers shall be designated with visible warning devices, such as tape, rope, or portable fence sections.
- b. *Signs.* Signs reading **"DANGER-DO NOT PASS THIS BARRIER," "DANGER HIGH VOLTAGE,"** or similar notice shall be placed along the barriers facing the working areas. For work aboveground on bus sections and associated equipment, distinctive flags on hooks or similar warnings placed near the energized circuits by hot sticks or other appropriate means may be used to indicate the hazard. Warning devices shall be installed at deenergized locations only, maintaining proper minimum distance to live parts. The placement of warning devices is the responsibility of the person receiving the Clearance for the work. When the work is finished, the person holding the Clearance shall be responsible for ensuring that the warning devices and safety barriers are removed before the Clearance is released.
- c. *Safety watch.* When it is not feasible to install barriers and signs, the person holding the Clearance shall provide a safety watch when work is in progress. When work in progress requires a worker to cross a barrier, the worker shall be continuously observed

by a designated employee to ensure that adequate distance to energized parts is maintained.

d. *Barrier tape.*

1. Plastic barrier tape can be an effective means to identify hazardous conditions or locations. When barrier tape is used, the individual in charge of the area will mark the tape with a barrier tag showing his/her name and phone extension.
2. Red plastic tape may be used to warn of dangerous conditions. Red plastic tape will mean **STOP, DANGER** or **DO NOT ENTER**. Personnel working inside of the taped area will be instructed on the requirements of the JHA for the taped area. Other personnel requiring entry must obtain approval from the individual in charge of the area after a proper briefing. Crossing over or under a red barrier tape without proper authorization is forbidden.
3. Yellow cloth tape with a black tracer is a NEMA (National Electrical Maintenance Association) standard for a high voltage barrier and shall mean the same as the red plastic tape. If used, the same restrictions on tagging and entry as shown above for red plastic tape shall be required.
4. Yellow plastic tape marked **CAUTION** will be used to identify hazards or conditions where caution is needed; e.g., tripping hazards, slippery conditions, pinch points, chemical hazards. Barrier tape can be used to supplement required protection for a floor opening, but barrier tape by itself is not sufficient. The use of yellow plastic tape does not prevent employees from entering an area, but does warn them of a hazardous condition.
5. Enforcement of violations of tape barrier requirements may be carried out in accordance with subsection 3.6 of this manual.

14.10 SWITCHING

14.10.1 **General.** Switching that will affect the system, operation, or control shall be performed only with the permission of the operations supervisor, as defined in FIST Volume 1-1.

14.10.2 **Switching personnel.** Switching personnel must wear approved hard hats and safety glasses during all phases of the switching program.

14.10.3 **Air-break switches.** The blades of air-break switches shall be physically checked open and mechanically locked in the open position, and the operating handle or lock shall be tagged with a Safety Tag. If the air-break switch is motor operated, the motor mechanism shall be mechanically uncoupled, locked, and tagged with a Safety Tag.

14.10.4 Ground switches. When use of ground switches is required to provide a safe work environment, the switches shall be closed and tagged with a Safety Tag and the perimeter of a clearance placed shall be expanded to include the switches.

14.10.5 Potential transformers. In placing Clearances on potential transformers or equipment to which potential transformers are connected, the equipment shall be properly isolated to prevent energizing the equipment from the low-voltage side. Fuses shall be removed with fuse tongs or other approved fuse tools. (See para. 14.18.9)

14.10.6 Relay testing/Hot Line Orders. Hot Line Orders shall **NOT** be issued on a power circuit while any work or tests are in progress on protective relays or control circuits that might affect the tripping of the circuit breaker(s) involved in the Hot Line Order. Conversely, when a Hot Line Order has been issued, no work or testing of associated relays or control circuits shall be performed.

14.10.7 Transformer secondary circuits. Secondary circuits of current transformers shall not be opened while the primary circuit is energized unless the secondary terminals of the transformer are effectively short circuited before the circuits are opened.

14.10.8 Test circuits. Temporary wiring or test circuits shall be safely installed and properly guarded, and shall be removed as soon as possible after completion of the work or tests.

14.10.9 Line fuses. Workers shall use fuse tongs or other approved fuse tools when installing or removing fuses on energized circuits. Workers and all other persons in the immediate area shall also wear safety glasses, safety goggles, or face shields to protect their eyes when fuses are being changed.

14.10.10 Capacitors. Capacitors shall be discharged and both terminals grounded, using a hot stick, before being touched or worked on. All failed capacitor cells shall be handled with extreme care and a JHA shall be performed before the cells are removed.

14.10.11 Lightning arrestors, coupling capacitors, and surge protection. This equipment shall be located or protected to prevent accidental contact. This equipment shall not be touched or approached until deenergized and all parts have been discharged to ground.

14.10.12 Metallic items near energized equipment. Metallic items including metallic or steel tapes, metal-lined rules, scales, and wire-bound hose or rope shall not be used on or near energized equipment.

14.10.13 Metal ladders. Portable metal ladders shall not be permitted in energized substations, powerplants, or in any area where there is danger of contacting energized circuits or equipment.

14.10.14 Work in penstocks, scrollcases, metal compartments, and damp areas. Only the following electrical systems are permissible when inspecting or working in penstocks,

scrollcases, draft tubes, metal compartments (such as generator enclosures, transformers, circuit breakers, and oil storage tanks), or in wet or damp locations where there is danger of electric shock:

a. Electrical circuits for lighting and handtools shall not exceed 120 volts and shall be protected by a UL-listed GFCI (ground-fault circuit interrupter) of one of the following types:

1. Branch circuit protector, mounted in a receptacle or in a distribution panel located adjacent to the work area
2. Portable multi-outlet interrupter plugged into standard three-wire grounded receptacle

The GFCI shall be rated to operate at 5 milliamperes and shall be equipped with an integral pushbutton test circuit. Such systems shall be installed in strict conformance with the manufacturer's specifications and shall be tested to verify proper operation before each use.

CAUTION: Although the GFCI affords a degree of protection not previously obtainable, there is no substitute for observing safe electrical practices at all times. Cords and connectors should be supported out of the water, or watertight connectors, sockets, and lamp-holders should be used. Rubber gloves shall be worn when handling wet energized connectors, or all connections shall be made with the circuit deenergized.

b. Electrically powered equipment, such as pumps, heaters, blowers, welders, isolating transformers, etc., used in these locations shall be connected to a circuit protected by a GFCI as described in "a." above or shall be properly grounded with a visible, flexible copper ground wire.

Air-powered, battery-operated, hydraulic tools, or handtools are preferred for work in these locations. Portable electric tools, either the double-insulated type or the three-wire grounded type, used in these locations shall be protected by a GFCI as described in "a." above. Under no circumstances shall an employee use an electric-powered tool (except portable, battery-operated tools at 24 volts or less) while standing in water.

14.10.15 Electrical brush replacement. Brushes on sliprings or commutators shall not be replaced while the machine is in operation.

14.10.16 Control rooms. No actions affecting the facility or system shall be performed by nonoperations personnel in an attended control room/control center without the consent of the operator on duty.

The atmosphere in the control room/control center shall be kept in a state conducive to the work being performed. Loud or boisterous behavior or any conduct that could distract attention from

the duties assigned is prohibited. The area shall not serve as a gathering place for personnel who are not currently performing a work assignment in the control room/control center.

14.11 TRANSMISSION AND SWITCHYARD FACILITIES

14.11.1 **General.** ALL HIGH-VOLTAGE CONDUCTORS AND ELECTRICAL EQUIPMENT SHALL BE CONSIDERED ENERGIZED UNTIL A PROPER CLEARANCE IS ISSUED AND THE CONDUCTORS OR EQUIPMENT BUZZED OUT AND PROPERLY GROUNDED.

14.11.2 **Work situations.** Supervisors and employees must recognize hazardous working conditions, either through personal observation or description by other employees. Supervisors, using input from their employees and with appropriate involvement of safety representatives, shall be responsible for determining the number of employees required to safely perform the work.

14.11.3 **Minimum distances.** Employees and objects they carry and machinery they operate shall remain beyond the minimum distances specified in subparagraph 12.10.4 from unprotected energized conductors and parts. Exceptions are live-line requirements covered by FIST Volume 3-29, "Energized Facility Maintenance."

14.11.4 **Parking prohibited under conductors.** Where feasible, line trucks, trailers, and other equipment shall be kept from under energized transmission or distribution conductors while work is performed on these conductors or their supports. Where not feasible, the minimum distances specified in subparagraph 12.9.2, shall be maintained between the equipment and the conductors.

14.11.5 **Ground duty.** An employee on the ground shall be designated to prevent people from passing under poles or lines on which work is being performed unless passage is necessary and specifically authorized by the supervisor.

14.11.6 **Conductive objects.** Metal tapes, fabric measuring tapes having metal threads, surveying rods, and other conductive objects shall be kept away from energized high-voltage lines and apparatus.

14.11.7 **Untying insulators.** When untying insulators, the tie wire shall be cut short enough so that it cannot reach any part of the supporting structure.

14.11.8 **First aid kits.** All vehicles used in transmission line work shall have first aid kits (16-unit minimum) supplemented with a bloodborne pathogen kit.

14.11.9 **Tailgate briefing.** Before starting transmission line or substation work, a tailgate briefing shall be held so that each member of the crew understands the job. The tailgate briefing shall involve the following:

- Reviewing the written procedure and/or the JHA.
- Ensuring that each person in the crew understands the entire task as well as their specific role or assignment.
- Ensuring that each person understands what every other crew member is to do.
- Ensuring that each person clearly understands the hazards or trouble spots involved and the precautionary measures to be taken.

Section 15

CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

15.1 SCOPE, APPLICATION, PURPOSE

15.1.1 **Scope.** This section covers the servicing and maintenance of machines and equipment in which the unexpected energization or start up of the machines or equipment, or release of stored energy could cause injury to employees. It establishes minimum performance requirements for the control of such hazardous energy at all Reclamation-operated facilities. Contractor work at Reclamation-owned and/or -operated facilities shall comply with any existing hazardous energy control procedures of the facility and the hazardous energy control program of FIST Volume 1-1. Requirements for electrical clearance procedures for use in controlling hazardous energy sources are contained in sections 12 and 28.

15.1.2 **Application.** This standard applies to the control of energy during servicing and/or maintenance of machines and equipment. This standard applies to any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy, but does not apply to the following:

- a. Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.
- b. Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products when they are performed on pressurized pipelines, provided that the employer demonstrates that: (1) continuity of service is essential; (2) shutdown of the system is impractical; and (3) documented procedures are followed and special equipment is used which will provide proven effective protection for employees.

15.1.3 **Purpose.** This section requires the establishment of a hazardous energy control program and the utilization of procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start up or release of stored energy in order to prevent injury to employees. When other sections require the use of lockout or tagout, they shall be used and supplemented by the procedural and training requirements of this section.

15.1.4 Definitions

Affected employee is an employee whose duties are normally to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee means a qualified person who is designated in writing by the responsible official to request, receive, and implement energy control procedures. The authorized employee (person) shall have knowledge of the type, magnitude, and hazards of the energy involved and the methods to be used to control the energy.

Capable of being locked out means that an energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability (i.e., vendor devices that will make energy isolating device lockable).

Energized means connected to an energy source or containing residual or stored energy.

Energy isolating device is a mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker, a disconnect switch, a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy source is any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot tap is a procedure used in the repair maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Job supervisor is any person authorized to request, receive, and release clearances and/or Hot Line Orders and who is charged with the responsibility of meeting the requirements of the Hazardous Energy Control Program during the job.

Lockout is the placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device is a device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Normal production operations means the utilization of a machine or equipment to perform its intended production function.

Responsible official is the official responsible for administration of the Hazardous Energy Control Program.

Servicing and/or maintenance means workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up is any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout is the placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device is a prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

15.2 HAZARDOUS ENERGY CONTROL PROGRAM

15.2.1 **Program.** The employer shall have a written Hazardous Energy Control Program that includes written procedures, employee training, and periodic inspections, to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, startup, or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source and rendered inoperative. (Refer to FIST 1-1.)

15.2.2 Lockout/tagout.

- a. If an energy isolating device is capable of being locked out, the Hazardous Energy Control Program required under paragraph 15.2.1 shall utilize lockout procedures, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection as set forth in paragraph 15.2.3.

b. If an energy isolating device is not capable of being locked out, the Hazardous Energy Control Program under paragraph 15.2.1 shall utilize a tagout system in compliance with section 15.3.

c. To the extent possible, lockout devices shall be required on all new replacements or additions. Renovation or modification of existing equipment or systems shall include hazardous energy isolating systems.

15.2.3 Full employee protection.

a. When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.

b. In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this section together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

15.2.4 Energy control procedure.

a. Procedures shall be developed, documented, and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.

Note: Exception: Documentation of the procedures is not required for a particular machine or equipment when all of the following elements exist: (1) the machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shut down which could endanger employees; (2) the machine or equipment has a single energy source which can be readily identified and isolated; (3) the isolation and locking out of that energy source will completely de-energize and deactivate the machine or equipment; (4) the machine or equipment is isolated from that energy source and locked out during servicing or maintenance; (5) a single lockout device will achieve a locked-out condition; (6) the lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance; (7) the servicing or maintenance does not create hazards for other employees; and (8) no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance have occurred.

b. The procedures shall clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy, and the means to enforce compliance including, but not limited to, the following:

1. A specific statement of the intended use of the procedure.
2. Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy.
3. Specific procedural steps for the placement, removal, and transfer of lockout devices or tagout devices and the responsibility for them.
4. Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

15.2.5 Protective materials and hardware .

a. Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided for isolating, securing, or blocking of machines or equipment from energy sources.

b. Lockout devices and tagout devices shall be singularly identified, shall be the only device(s) used for controlling energy, shall not be used for other purposes, and shall meet the following requirements:

1. *Durable.* (a) Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected. (b) Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible. (c) Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

2. *Standardized.* Lockout and tagout devices shall be standardized within the facility (Reclamation-wide) in color, shape, and size.

3. *Substantial.* (a) **Lockout devices.** Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools. (b) **Tagout devices.** Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a nonreusable type, attachable by hand, self-locking, and nonreleasable with a minimum unlocking strength of no less than 50 pounds and having the general design

and basic characteristics of being at least equivalent to a one-piece, all environment-tolerant nylon cable tie.

4. *Identifiable*. Lockout devices and tagout devices shall indicate the identity of the employee applying the device(s).

c. Tagout devices shall warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as: **DO NOT START, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, DO NOT OPERATE**, etc.

15.2.6 Periodic inspection. Periodic inspections shall be conducted to ensure that all requirements of the hazardous energy control program are being followed. As a part of the inspection, each energy control procedure utilized at the facility shall be inspected. The responsible official shall certify that the periodic inspections have been performed. The certification shall specify the system on which the energy control procedures were utilized when inspected, the date of the inspections, and the names of personnel performing and included in the inspections.

a. Periodic inspections of energy control procedures shall be conducted by a qualified individual other than that utilizing the specific hazardous energy control procedure being inspected.

b. Periodic inspections of hazardous energy control programs and procedures shall include a review between the inspector and personnel involved in use of the procedures to assess individual personal knowledge of, and responsibilities under the program.

c. Any deficiencies shall be documented and appropriate measures implemented to correct the deficiencies and to ensure future compliance.

15.2.7 Training and communication.

a. Training shall be provided to ensure that the purpose and procedures of the energy control program are understood and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees. All employees involved with hazardous energy control procedures shall have initial training and must demonstrate adequate working knowledge of hazardous energy control policies and local programs and procedures prior to placement on the list of authorized personnel. The training shall include the following:

1. Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.

2. Each affected employee shall be instructed in the purpose and use of the energy control procedure.

3. All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out or tagged out.

b. When tagout systems are used, employees shall also be trained in the following limitations of tags:

1. Tags are essentially warning devices affixed to energy isolating devices, and do not provide the physical restraint on those devices that is provided by a lock.
2. When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.
3. Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.
4. Tags and their means of attachment must be made of materials which will withstand the environmental conditions encountered in the workplace.
5. Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.
6. Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

c. Retraining shall be provided:

1. For all authorized and affected employees whenever there is a change in their job assignments, a change in systems or processes that present a new energy control hazard, or when there is a change in the energy control procedures.
2. Whenever a periodic inspection reveals, or there is reason to suspect the presence of deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.
3. At least annually.

The responsible official shall certify and document all training and retraining. Certification shall contain such information as the name of the person, the time, date, and location of training, the name of the trainer, etc.

15.2.8 Energy isolation. Lockout or tagout shall be performed only by the authorized employees who are performing the servicing or maintenance.

15.2.9 Notification of employees. Affected employees shall be notified by the job supervisor or authorized employee of the application and removal of lockout devices or tagout devices. Notification shall be given before the controls are applied and after they are removed from the machine or equipment.

15.3 APPLICATION OF CONTROL. The established procedures for the application of energy control (the lockout or tagout procedures) shall cover the following elements and actions and shall be done in the following sequence:

15.3.1 Preparation for shutdown. Before an authorized or affected employee turns off a system (machine or equipment), the authorized employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

15.3.2 System (machine or equipment) shutdown. The machine or equipment shall be turned off or shut down using the procedures established for the machine or equipment. An orderly shutdown must be utilized to avoid any additional or increased hazard(s) to employees as a result of the equipment stoppage.

15.3.3 System (machine or equipment) isolation. All energy isolating devices that are needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate it from the energy source(s).

15.3.4 Lockout or tagout device application.

a. Lockout or tagout devices shall be affixed to each energy isolating device by authorized employees.

b. Lockout devices, where used, shall be affixed in a manner that will hold the energy isolating devices in a "safe" or "off" position.

c. Tagout devices, where used, shall be affixed in such a manner as will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.

1. Where tagout devices are used with energy isolating devices designed with the capability of being locked, the tag attachment shall be fastened at the same point at which the lock would have been attached.

2. Where a tag cannot be affixed directly to the energy isolating device, the tag shall be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

15.3.5 **Stored energy.**

- a. Following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, and otherwise rendered safe.
- b. If there is a possibility of reaccumulation of stored energy to a hazardous level, verification of isolation shall be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

15.3.6 Verification of isolation. Prior to starting work on machines or equipment that have been locked out or tagged out, the authorized employee shall verify that isolation and deenergization of the machine or equipment have been accomplished.

15.4 RELEASE FROM LOCKOUT OR TAGOUT. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by the authorized employee(s) to ensure the following:

15.4.1 The machine or equipment. The work area shall be inspected to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

15.4.2 Employees.

- a. The work area shall be checked to ensure that all employees have been safely positioned or removed.
- b. Before lockout or tagout devices are removed and before machines or equipment are energized, affected employees shall be notified that the lockout or tagout devices will be removed.
- c. After lockout or tagout devices have been removed and before a machine or equipment is started, affected employees shall be notified that the lockout or tagout device(s) have been removed.

15.4.3 Lockout or tagout devices removal. Each lockout or tagout device shall be removed from each energy isolating device by the employee who applied the device. An exception may be granted when the authorized employee who applied the lockout or tagout device is not available to remove it. That device may be removed under the direction of the responsible official, provided that specific procedures and training for such removal have been developed, documented, and incorporated into the employer's energy control program. The responsible official shall demonstrate that the specific procedure includes at least the following elements:

- a. Verification by the responsible official that the authorized employee who applied the device is not at the facility.

- b. Making all reasonable efforts to contact the authorized employee to inform him/her that his/her lockout or tagout device has been removed.
- c. Ensuring that the authorized employee has this knowledge before he/she resumes work at that facility.

15.5 OPERATING EQUIPMENT UNDER CLEARANCE

15.5.1 Testing or positioning of machines, equipment or components thereof. In situations in which lockout or tagout devices must be temporarily removed from the energy isolating device and the machine or equipment energized to test or position the machine, equipment, or component thereof, the following sequence of actions shall be followed:

- a. Clear the machine or equipment of tools and materials in accordance with paragraph 15.4.1.
- b. Remove employees from the machine or equipment area in accordance with paragraph 15.4.2.
- c. Remove the lockout or tagout devices as specified in paragraph 15.4.2.
- d. Energize and proceed with testing or positioning.
- e. Deenergize all systems and reapply energy control measures in accordance with paragraph "d." above to continue the servicing and/or maintenance.

15.5.2 Outside personnel (contractors, etc.).

- a. Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this standard, the on-site responsible official and the outside employer shall inform each other of their respective lockout or tagout procedures.
- b. The on-site responsible official shall ensure that his/her employees understand and comply with the restrictions and prohibitions of the outside employer's energy control program.

15.5.3 Group lockout or tagout (also refer to FIST Volume 1-1).

- a. When servicing and/or maintenance is performed by a crew, craft, department or other group of employees, they shall utilize a procedure which affords a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.
- b. Group lockout or tagout devices shall be used in accordance with the procedures required by paragraph 15.2.4 and FIST Volume 1-1 including, but not necessarily limited to, the following specific requirements:

1. Primary responsibility for the personnel working under the protection of a group lockout or tagout device, and for the device itself, shall be vested in the job supervisor. The authorized individual shall ascertain the exposure status of individual group members with regard to the lockout or tagout of the system.
2. When group lockout is used, each worker shall affix a personal lockout device to a group lockbox, or comparable mechanism when he/she begins work and shall remove these devices when he/she is no longer affected.
3. When more than one crew, craft, department, etc., is involved, assignment of overall job-associated lockout or tagout control responsibility shall be prescribed in the written procedure.

15.5.4 Shift or personnel changes. Specific procedures shall be utilized during shift or personnel changes to ensure the continuity of lockout or tagout protection, including provision for the orderly transfer of lockout or tagout device protection between offgoing and oncoming employees, to minimize exposure to hazards from the unexpected energization or start-up of the machine or equipment, or the release of stored energy.

Note: Appendix E serves as a nonmandatory guideline to assist employers and employees in complying with the requirements of this section, as well as to provide other helpful information. Nothing in the appendix adds to or detracts from any of the requirements of this section.

Section 16

HANDTOOLS, POWERTOOLS, PRESSURE VESSELS, AND WELDING

16.1 GENERAL

16.1.1 **Maintenance.** Handtools, powertools, and jacks shall be maintained in safe operating condition and used only for the purpose which they were designed. Damaged and defective tools shall be repaired or removed from service. Electrical cords shall not be used to raise or lower tools.

16.1.2 **Storage.** Tools shall not be left on scaffolds or elevated work spaces, and containers shall be provided for handtools on the jobsite.

16.1.3 **Guarding.** Tools designed to accommodate guards shall be operated with such guards in place. Belts, gears, shafts, pulleys, sprockets, spindles, drums, and other type moving drives shall be isolated or guarded as set forth in the current edition of ANSI B15.1, "Safety Code for Mechanical Power Transmission Apparatus."

16.1.4 **Grounding.** Electric-powered tools shall be double insulated or effectively grounded as set forth in subsections 12.4 and 12.5.

16.1.5 **Switches.** On-off switches controlling the operation of hand-held powered tools shall conform to the following requirements.

- a. Hand-held powered platen sanders, grinders with 2-inch or less diameter wheels, routers, planers, laminate trimmers, nibblers, shears, scroll saws, and jigsaws with blade shanks 0.25 inch wide or less may be equipped with only a positive on-off control.
- b. Hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels exceeding 2 inches in diameter, disk sanders, belt sanders, reciprocating saws, and similar tools shall be equipped with a momentary contact on-off control. They may have a lock-on control provided the power can be shut off by a single motion of the same finger(s) that turns it on, and the switch is adequately guarded to prevent accidental operation.
- c. Jackhammers, and similar pneumatic-powered handtools and other hand-held powertools including chain saws, circular saws, and percussion tools shall be equipped with a constant pressure switch that shuts off power when pressure is released. This paragraph does not apply to concrete vibrators.

16.1.6 Personal protective equipment. Handtool and powertool operators shall be provided with and use respective type(s) of personal protective equipment as set forth in section 8.

16.1.7 Hazardous conditions. Only nonsparking tools shall be used in locations where sources of ignition may cause an explosion or fire. Gasoline-powered tools shall not be used underground or in locations where toxic exhaust gases can accumulate. Impact tools including drift pins, wedges, and chisels shall be kept in a dressed condition or equipped with nonmushrooming heads. Employees shall not work under areas where hand-held tools are being used unless the tools are equipped with restraining straps or appropriate decking, planking, and netting are provided for employee protection.

16.2 PNEUMATIC TOOLS

16.2.1 Impact tools. Pneumatic impact tools shall be operated with safety clips or retainers installed to prevent tools being accidentally discharged from the chuck.

16.2.2 Air hoses. All connections, couplings, and splices in air lines exceeding 0.5-inch inside diameter shall be equipped with clips and wire rope or chain lashings. The clips and lashings will be installed in a manner that prevents whipping of the hose line should the connection, coupling, or splice fail. A safety device at the source of supply or branch line which will automatically reduce pressure in case of a line failure may be substituted provided the device is demonstrated as effective in preventing whipping.

16.2.3 Operating pressures. The manufacturer's safe operating pressure for hoses, pipes, valves, and fittings shall not be exceeded. Defective hoses, valves, and fittings shall not be exceeded. Defective hoses, valves, and fittings shall be removed from service.

16.2.4 Compressed air. Compressed air shall not be directed at any part of the body. Compressed air shall not be used for cleaning purposes except when reduced to less than 30 pounds per square inch and the operator protected by personal protective equipment as set forth in section 8. The 30 pounds per square inch requirement does not apply to sandblasting, green cutting, removal of mill scale, cleaning concrete forms, and similar cleaning operations.

16.2.5 Care of air hoses. Air hoses shall not be used for hoisting or lowering tools. Hoses shall not be laid on ladders, steps, scaffolds, or walkways in a manner creating a tripping hazard.

16.2.6 Airless spray guns. Airless spray guns shall be equipped with safety devices which will prevent pulling of the trigger until the safety device is manually released. In addition to the above, a diffuser nut to prevent high pressure release when the nozzle tip is removed and a nozzle tip guard to prevent the tip from contacting the operator or other equivalent protection shall be provided.

16.2.7 Nailers. Pneumatically driven nailers, staplers, and similar equipment provided with automatic fastener feed, which operate at more than 100 pounds per square inch, shall have a

single-action trigger and a safety device on the muzzle to prevent the ejection of the fasteners unless the muzzle is in contact with the work surface.

16.3 GRINDING TOOLS

16.3.1 **Requirement.** The installation, guarding, use, and care of grinding tools shall comply with the standards set forth in the current ANSI B7.1, "Safety Code for the Use, Care, and Protection of Abrasive Wheels." Grinding tools shall not be used without the safety guards, protective flanges, and tool rests installed and maintained in proper adjustment.

16.3.2 **Abrasive wheels.** Abrasive wheels and scratch brush wheels shall not be operated in excess of their rated safe speed. Cracked or defective abrasive wheels shall be removed from service immediately.

16.3.3 **Bench grinders.** Bench-mounted and floor-stand grinders shall be provided with safety guards that are strong enough to withstand the effect of a bursting wheel. The guard shall not expose more than 90 degrees of the grinding wheel periphery and sides, except if the work is required to contact the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 125 degrees. The guard shall be provided with a readily adjustable toolrest that is maintained within 1/8 inch of the wheel, and an adjustable tongue maintained within 1/4 inch of the periphery of the wheel.

16.3.4 **Cup-type wheels.** Cup-type wheels used for external grinding shall be protected by either a revolving cup guard or a band-type guard.

16.3.5 **Right angle head grinders.** Right angle head grinders shall be provided with a guard having a maximum exposure angle of 180 degrees. The guard shall be located so as to be between the operator and the wheel.

16.3.6 **Inspection.** All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks and defects.

16.3.7. **Side grinding.** Side grinding shall not be permitted unless the abrasive wheel is specifically designed for this purpose.

16.4 WOODWORKING TOOLS

16.4.1 **Requirement.** The installation, guarding, use, and care of power-operated woodworking tools shall comply with the standards set forth in 29 CFR Part 1910.213 "Woodworking Machinery Requirements."

16.4.2 **Switches.** Switches shall be located to enable the operator to cut off the power without leaving his/her operating position. Fixed power-driven tools shall be provided with a disconnect switch that can be locked in the off position.

16.4.3 **Automatic feed.** Whenever the nature of the work will permit, automatic feeding devices shall be installed on fixed power-driven woodworking tools. Feeder attachments shall have the feed rolls and/or other moving parts guarded to protect the operator.

16.4.4 **Electrical equipment.** When automatic restarting would create a hazard, electrically driven equipment shall be controlled with a device which will prevent automatic restarting following a power failure.

16.4.5 **Push sticks.** A push stick, block, or similar safe means shall be used for all operations close to high-speed cutting edges.

16.4.6 **Combs.** Combs (featherboards) or suitable jigs shall be provided for use when standard guards cannot be used.

16.4.7 **Planers and joiners.** Planers and joiners shall be equipped with cylindrical cutting heads and fully guarded.

16.4.8 **Cleanup.** Work areas shall be kept clean and a brush provided at each machine to remove sawdust, chips, and shavings.

16.5 POWER SAWS

16.5.1 **Circular saws.** Bench-type circular saws shall be equipped with spreaders, anti-kickback devices, and guards that automatically enclose the exposed cutting edges. Portable hand-held circular saws shall be equipped with guards above and below the baseplate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. As the blade is withdrawn, the lower guard shall automatically and instantly return to the covering position.

16.5.2 **Operating speeds.** The operating speed shall be permanently marked on all circular saws over 20 inches in diameter or operating speeds over 10,000 peripheral feet per minute. Only blades designed for use at the marked operating speed shall be used. When the saw is retensioned for a different speed, the marking shall be changed to indicate the new speed.

16.5.3 **Radial arm saws.** Radial arm saws and swing cutoff saws shall be equipped with (1) limit stops which prevent the leading edge of the blade from traveling beyond the edge of the table, (2) hoods and/or guards that protect the operator from flying material, direct the sawdust toward the back of the blade, and enclose all parts of the blade not in contact with the material being cut, (3) automatic brakes or automatic return devices and, (4) nonkickback fingers or dogs and spreader shall be installed when ripping.

16.5.4 **Bandsaws.** Bandsaw blades shall be fully enclosed except at the point of operation. The adjustable guide shall be adjusted within 1/2 inch of the work.

16.5.5 **Unattended.** Power saws shall not be left running unattended.

16.5.6 **Sawdust collectors.** Bench-type circular saws and radial saws used for production work shall be equipped with enclosed sawdust collectors.

16.5.7 **Cleanup.** Scrap and sawdust shall not be permitted to accumulate. The shop area shall be cleaned up at the end of each shift.

16.5.8 **Defective blades.** Cracked, bent, or otherwise defective blades shall be removed from service.

16.6 HYDRAULIC-POWERED TOOLS

16.6.1 **Safe operating pressures.** The manufacturer's safe operating pressure for hoses, valves, pipes, filters, and fittings shall not be exceeded.

16.6.2 **Hydraulic fluid.** Fluid in hydraulic-powered tools shall be fire resistant type approved by a recognized authority, such as Underwriters Laboratories or Factory Mutual.

16.6.3 **Stationary hydraulic-powered presses.** Presses shall be provided with guards that adequately contain flying particles forcibly expelled from the material being compressed.

16.7 POWDER-ACTUATED TOOLS

16.7.1 **Requirement.** Powder-actuated tools shall be designed, maintained, and used in accordance with the standards set forth in the current edition of ANSI A10.3, "Safety Requirements for Powder-Actuated Fastening Systems," and the requirements of this subsection.

16.7.2 **Operator qualification.** Powder-actuated tools shall be operated and serviced only by persons who have been trained and certified in the safe use of such tools. Operators must possess an operator's card issued by a firm or person authorized to issue such cards.

16.7.3 **Unauthorized use.** Safeguards shall be taken to prevent the possession or use of these tools and their charges by unauthorized persons.

16.7.4 **Flammable atmospheres.** Powder-actuated tools shall not be used in explosive or flammable atmospheres.

16.7.5 **Studs and fasteners.** Only powder charges, studs, or fasteners specified by the manufacturer for the specified tool shall be used.

16.7.6 **Safety features.** Tools shall be designed to operate only when pressed against the work surface with a force at least 5 pounds greater than the weight of the tool. They shall be constructed so the tool cannot fire when dropped or during loading or preparation to fire.

16.7.7 **Materials.** Driving fasteners into soft or easily penetrated material is prohibited unless the material is backed to prevent complete penetration. Tools shall not be used on very hard or brittle materials such as cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile.

16.7.8 **Use.** Tools shall not be loaded until just prior to firing. Loaded tools shall not be left unattended. Tools shall not be pointed at any person, and all parts of the body shall be kept clear of the muzzle.

16.7.9 **Inspecting.** Tools shall be inspected each day before loading to ensure that the safety devices are in proper working order. The inspection shall be conducted in accordance with the manufacturer's recommended inspection procedures.

16.7.10 **High-velocity tools.** High-velocity tools shall be used only for those applications where low-velocity tools will not meet the job requirements.

16.8 HAND-POWERED WINCHES AND HOISTS

16.8.1 **Rated capacity.** Hand-powered winches and hoists shall be used within the manufacturer's rated capacity, and the capacity shall be legibly marked on the winch or hoist.

16.8.2 **Cranks.** The use of handcranks is prohibited unless the winch or hoist is equipped with positive self-locking dogs or the worm-gear type. Handwheels shall not have projecting spokes or knobs.

16.9 LEVER AND RATCHET, SCREW, AND HYDRAULIC JACKS

16.9.1 **Capacity.** The manufacturer's rated capacity shall be legibly marked on all jacks and shall not be exceeded.

16.9.2 **Overtravel.** Jacks, of any type, shall have a positive stop to prevent overtravel.

16.9.3 **Footing and blocking.** Jacks shall be set on a stable and firm footing, and cribbed or blocked where necessary to prevent settlement or dislodgement. Where there is a possibility of slippage, a wood block shall be placed between the jack and the load.

16.10 COME-ALONG

16.10.1 **Capacity.** The manufacturer's rated capacity shall be legibly marked on all come-alongs and shall not be exceeded.

16.10.2 **Defects.** Come-alongs shall be removed from service when they have worn or kinked cables or links, deformed hooks, or defective ratcheting devices.

16.10.3 **Structures.** Care shall be taken to not overstress structures or structure supporting systems when using come-alongs for leveling, plumbing, or positioning structures.

16.11 HANDTOOLS

16.11.1 **Wrenches.** Wrenches, including adjustable, pipe, and socket wrenches shall not be used when jaws are sprung to the point that slipping occurs.

16.11.2 **Wood handles.** The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight in the tool.

16.12 GENERAL--BOILERS AND UNFIRED PRESSURE VESSELS

16.12.1 **Design and installation.** Boilers shall be designed, constructed, installed, tested, and maintained in accordance with the ASME "Boiler and Pressure Vessel Code." Unfired pressure vessels including air receivers shall be designed, constructed, installed, tested, and maintained in accordance with the ASME "Boiler and Pressure Vessel Code." Prior to installing boilers or unfired pressure vessels or moving them into states having boiler codes, the boiler or unfired pressure vessel shall be checked for compliance with codes.

16.12.2 **Inspection and testing.** Boilers and unfired pressure vessels shall be inspected and tested prior to being placed in service, and after any alteration or major repair. Subsequent inspections shall be performed within a 24-month period for the first inspection, followed by inspections at intervals not to exceed 60 months (providing deterioration is shown to be low and at a predictable rate). Where deterioration is shown to be rapid in any part of a vessel, an inspection and testing interval of 24 months shall be used. Hydrostatic or State acceptable tests shall be made when recommended by the qualified person performing the inspection.

16.12.3 **Inspector qualifications.** Inspections shall be performed by qualified personnel meeting Federal and State certification requirements, by personnel satisfying the "Owner-User Inspector" education and experience qualification requirements of API 510, issued by the American Petroleum Institute, or by personnel satisfying the "Owner-User Inspector" education and experience of the National Board Inspection Code, issued by the National Board of Boiler and Pressure Vessel Inspectors.

16.12.4 **Posting reports.** A copy of the inspector's approval or certification reports shall be posted near or on the boiler or unfired pressure vessel.

16.13 UNFIRED PRESSURE VESSELS

16.13.1 **Design and installation.** Unfired pressure vessels, including air receivers installed on air compressors, controls, safety valves, and component parts shall be constructed, installed, tested, and maintained in accordance with the ASME "Code for Unfired Pressure Vessels." Hydrostatic or State-acceptable tests shall be made in accordance with the requirements set forth in paragraph 16.12.2.

16.13.2 **Drain valves.** A readily accessible drain valve shall be installed on the lowest point of every air receiver to remove accumulations of oil and water. Operation of the valve shall be as recommended by the manufacturer to remove accumulations of liquid.

16.13.3 **Piping.** Piping shall be installed with traps or other effective means of removing liquid from the lines. Air discharge piping shall be installed to eliminate possible oil pockets.

16.13.4 **Stop valves.** A stop valve shall be installed between the receiver and each piece of stationary utilization equipment and also at each outlet to which an air hose may be attached.

16.13.5 **Air receivers.** Air receivers shall be installed in locations providing convenient access for maintenance. Drains, handholes, and manholes shall be easily accessible. Receivers shall not be buried underground or located in damp locations. The receiver should be located in a cool place to facilitate condensation of moisture and oil vapors.

16.13.6 **Flammable and toxic gases.** The compressor intake shall be located to prevent any possibility of flammable or toxic gas, vapor, or dust from being drawn into the compressor.

16.13.7 **Air intake.** No valve shall be installed in the air intake pipe to an air compressor with an atmospheric intake.

16.13.8 **Discharge piping.** Air discharge piping from the compressor to the receiver shall be at least as large in diameter as the discharge opening on the compressor. If a stop valve is installed between the compressor and the receiver, spring-loaded safety valves shall be installed between the stop valve and the compressor. The total capacity of the safety valves shall be sufficient to limit pressures in the air discharge piping to less than 10 percent or 3 pounds per square inch (whichever is greater) above the working pressure of the piping.

16.13.9 **Hose and hose connections.** Compressed air hose and hose connections shall be designed for the pressure and service to which they are subjected.

16.13.10 **Governors.** A speed governor, independent of the unloaders, shall be installed on all compressors except those driven by electric synchronous motors. Engine- or turbine-driven compressors shall be equipped with an auxiliary control to the governor to prevent racing when the unloader operates.

16.13.11 **Limit and bypass.** Every air compressor shall automatically stop compressing before the discharge pressure exceeds the maximum allowable working pressure of the weakest portion of the system. Electrical contacts shall be designed and installed so that they cannot lock or fuse in a position that would permit the compressor to continue compressing when the allowable pressure is exceeded. An air bypass and alarm may be installed as a substitute for the automatic stop system. Each stage of a multistage compressor shall be equipped with a safety relief valve.

16.14 BOILERS

16.14.1 **Requirement.** Boilers and fired pressure vessels shall be designed, constructed, installed, operated, and maintained in accordance with the standards of the ASME "Boiler and Pressure Vessel Code." Prior to being placed in operation, they shall be inspected and certified as provided in paragraph 16.12.2.

16.15 COMPRESSED GAS CYLINDERS

16.15.1 **Requirement.** Compressed gas cylinders shall be constructed, inspected, and tested in accordance with Department of Transportation requirements.

16.15.2 **Cylinder storage.** Onsite storage of gas cylinders shall conform to the following requirements:

- a. *Separation.* Cylinders containing the same gas shall be stored in segregated groups and not intermingled with other gas cylinders. Empty gas cylinders shall be stored in the same manner.
- b. *Confined spaces.* Cylinders shall be stored in well-ventilated spaces. Cylinders containing oxygen, acetylene, or fuel gases shall not be stored or taken into confined spaces.
- c. *Flammable or combustible material.* Cylinders in storage shall be separated from flammable or combustible material by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating, and at least 5 feet high.
- d. *Oxidizing gases.* Cylinders containing oxygen or oxidizing gases shall be separated from fuel gas cylinders by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating, at least 5 feet high.
- e. *Smoking restrictions.* Smoking or open flame shall not be permitted where cylinders are stored and the area posted with "**DANGER---NO SMOKING**" or "**OPEN FLAME**" signs.
- f. *Toxic gas.* Areas containing toxic gas in storage shall be appropriately posted.

16.15.3 **Upright position.** Compressed gas cylinders shall be secured in an upright position at all times except when being hoisted or used in special services or arrangements approved in writing by the manufacturer or gas supplier.

16.15.4 **Cylinder valves.** Cylinder valves shall be closed when cylinders are in storage, in transit, or not in use.

16.15.5 **Valve caps.** Cylinder valve caps shall be securely in place during storage, transit, and at all times when the regulator is not connected to the cylinder. Cylinders, secured on specialty trucks, may be moved within a jobsite without the regulators removed when the regulators and cylinder valves are adequately protected.

16.15.6 **Transporting.** Compressed gas cylinders transported by crane, hoist, or derrick shall be transported in cradles, nets, or skips; never directly by slings, chains, or magnets.

16.15.7 **Valve wrenches.** The valve wrench or wheel shall be in the operating position when the cylinder is in use.

16.15.8 **Restricted use.** Cylinders shall be used only for the designated purpose of containing a specific compressed gas for which they were designed. They shall be refilled only by the supplier.

16.15.9 **Handling.** Cylinders shall be handled in a manner which will not weaken or damage the cylinder or valve. They shall not be exposed to extremes of temperature, physical damage, or electrical current.

16.15.10 **Oxygen.** Oxygen cylinders and fittings shall be kept free of oil or grease and shall not be handled with oily hands or gloves. Oxygen shall not be directed at oily surfaces, greasy cloths, or into a container, storage tank, or vessel. Oxygen or other compressed gases shall not be used as a substitute for compressed air.

16.15.11 **Defective cylinders.** Leaking cylinders shall be removed to an isolated location out of doors, away from personnel, and sources of ignition. The valve shall then be cracked, permitting the gas to escape slowly. The cylinder shall be tagged **DEFECTIVE** and returned to the supplier. Leaking cylinders containing toxic gas shall be handled only by qualified personnel protected by appropriate personal protective equipment.

16.16 GENERAL WELDING AND CUTTING

16.16.1 **Applicable standards.** All welding and cutting apparatus, equipment, and operations shall be in accordance with the standards and recommendations set forth in the current edition of ANSI Z49.1, "Safety in Welding and Cutting," and the requirements of this section.

16.16.2 **Daily inspection.** Welding apparatus and equipment shall be inspected daily prior to use. Defective apparatus and equipment shall be removed from service, replaced, or repaired and reinspected before being used again.

16.16.3 **Fire extinguishers.** Fire extinguishers rated 2-A:40-B:C units or larger shall be immediately available wherever welding or cutting is being carried out.

16.16.4 **Fire protection.** The following precautions shall be taken, as applicable, when welding or cutting:

a. *Flammable material.* Welding shall, whenever possible, be confined to areas free of combustible materials. When this is not possible, all combustible material shall be removed or protected from fire, sparks, and slag.

b. *Fireguards.* When welding, cutting, or heating is such that normal fire prevention precautions are not considered adequate, fireguards shall be assigned to the operation. They shall be on duty during the operations and for a sufficient period of time following the completion of the work to ensure that no possibility of fire exists. Fireguards shall be provided with necessary fire protection equipment and instructed in its use.

c. *Tests.* Before welding, cutting, or heating any material covered by a preservative coating whose flammability is unknown, a test shall be made to determine its flammability. No welding or cutting shall be done in any area that could contain flammable vapors or gases until the atmosphere has been tested and found safe.

d. *Shafts.* Noncombustible barriers shall be installed below welding or burning operations in or over a shaft or raise.

e. *Flammable and combustible liquids.* No welding, cutting, or burning shall be done in areas containing flammable and/or combustible liquids, vapors, or dusts.

f. *Walls.* When welding or cutting are performed on walls, floors, or ceilings where direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent area, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.

16.16.5 Goggles and protective clothing. Welders and helpers shall wear protective clothing and eye protection as specified in subsections 8.3 and 8.6. Further, other persons shall be protected from exposure to welding rays, flashes, sparks, molten metal, and slag. Welding screens shall be installed in repair shops and other areas where welding is done regularly.

16.16.6 Preservative coatings. When preservative coatings are highly flammable, they shall be removed from the area to be heated in order to prevent ignition. The following precautions shall be taken when the coatings are determined to be toxic:

a. *Enclosed spaces.* Welding and cutting in enclosed spaces will conform to requirements of subsection 7.8. Additionally, all coated surfaces shall be stripped of the coating for a distance of at least 4 inches on each side of the cut or weld.

b. *Open air.* Employees in open air shall be protected by either an air line respirator, an appropriate respirator meeting the requirements of section 8, or adequate local ventilation.

16.16.7 Ventilation. Ventilation and protection of employees welding, cutting, or heating in confined spaces shall conform to requirements contained or referenced in subsection 7.8, "Confined Spaces." Employees welding, cutting, heating, brazing, or using fluxes, coatings,

and filler materials containing the following materials shall be protected in accordance with requirements of subsections 3.5, 7.2, 8.4, ANSI Z49.1 Section 5, "Ventilation".

- a. Cadmium
- b. Fluorides
- c. Mercury
- d. Chlorinated hydrocarbons
- e. Stainless steel
- f. Zinc or galvanized materials
- g. Beryllium
- h. Lead
- i. Other materials or compounds determined to be toxic by the manufacturer or national recognized source referenced in 29 CFR Part 1910

16.16.8 Flammable liquid containers. When it is necessary to cut or weld closed containers or hollow structures, which have contained flammable materials, the recommendations contained in the pamphlet "F4.1, Recommended Safe Procedures for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances" published by the American Welding Society, shall be followed.

16.17 GAS WELDING AND CUTTING

16.17.1 Equipment. Gas welding and cutting equipment shall be as listed by Underwriters Laboratories, Inc., or by Factory Mutual.

16.17.2 Gas cylinders. Gas cylinders shall be constructed, transported, handled, stored, used, and maintained as set forth in subsection 16.15.

16.17.3 Regulators. Pressure-reducing regulators shall be used only for the gas for which they were designed. Except for cracking the valve slightly to remove dust or dirt, gas shall not be released from a cylinder under pressure without attaching the pressure-reducing regulator to the cylinder valve. Acetylene regulators shall not be adjusted to permit a discharge greater than 15 pounds per square inch (gauge).

16.17.4 Torches. Torch valves shall be closed and the gas supply shut off when work is suspended. Torch valves shall be checked for leaks at the beginning of each shift. Torches shall be lighted by friction lighters or other approved devices and not by matches or from hot work.

16.17.5 Check valves. All oxygen, acetylene, or other fuel gas-oxygen combinations used in cutting or welding shall have reverse flow check valves installed between the hose and the regulator.

16.17.6 Welding hose. Only properly marked and identified hose in good condition and specifically manufactured for oxyacetylene service shall be used for gas welding and cutting.

Hose, which has been subjected to flashback or which indicates evidence of severe wear or damage, shall be removed from service. Containers used for storage of fuel gas hose shall be ventilated.

16.18 ARC WELDING AND CUTTING

16.18.1 **Applicable standards.** Electric arc welding apparatus shall comply with the National Electrical Manufacturer's Association EW1 "Electric Arc Welding Power Sources" and shall be installed, operated, and maintained in accordance with ANSI Z49.1, "Safety in Welding and Cutting."

16.18.2 **Power circuits.** Power circuits for electric arc welding equipment shall be installed and maintained in accordance with applicable provisions of the current NEC (National Electrical Code).

16.18.3 **Grounding.** Frames of all electric welding machines operated from power circuits shall be effectively grounded in accordance with current NEC standards. The ground for electric welding circuits shall be both mechanically and electrically adequate. Pipelines containing flammable gases or liquids, electrical conduits, chains, wire rope, cranes, hoists, or similar devices shall not be used for a ground.

16.18.4 **Cables.** Splices or repaired insulation shall not be permitted within 10 feet of the electrode holder. Cables shall be positioned so as not to create obstructions on walkways, scaffolds, stairs, or ladders.

16.18.5 **Gasoline-driven arc welders.** Gasoline-driven arc welders shall not be used in confined spaces, or underground in tunnels, shafts, conduits, etc.

16.19 INERT-GAS METAL-ARC WELDING

16.19.1 **Chlorinated solvents.** Application of chlorinated solvents shall not be done within 200 feet of the exposed arc. Surfaces prepared with chlorinated solvents shall be thoroughly dry before welding is permitted on such surfaces.

16.19.2 **Arc protection.** Employees exposed to the arc shall be required to wear goggles with filter lenses. When two or more welders are exposed to each other's arc, filter lens goggles of suitable type shall be worn under the welding helmets. Hand shields designed to dissipate radiant energy shall be used when either the helmet is lifted or the shield is removed.

16.19.3 **Radiation.** Welders and persons exposed to radiation shall wear protective clothing completely covering the skin to prevent harmful effects of ultraviolet rays.

Section 17

ROPES, SLINGS, CHAINS, AND ACCESSORIES

17.1 GENERAL

17.1.1 **Standard criteria.** The *Rigging Manual* published by the Construction Safety Association of Ontario, 74 Victoria Street, Toronto, Canada, M5C2A5 has been designated the *Reclamation Rigging Manual*. This manual will be used by Reclamation as a guide in determining whether rigging practices are safe and in conformance with industry-wide practices. While its use by Reclamation and contractors is recommended, both as a rigging manual and a training text, contractually it is advisory in nature except where specifically referenced, and intended only to complement the safety requirements set forth in this section.

17.1.2 **Safe usage.** The use of ropes, slings, and chains shall be in accordance with the safe usage recommendations of the equipment manufacturer, this subsection and appendixes L and S.

17.1.3 **Safe working loads.** The safe working load of ropes, slings, chains, accessories, and rigging equipment shall be determined prior to use. The safe working load shall not be exceeded. Safe working loads for specified types and sizes of ropes, slings, chains, and accessories shall be as set forth in this section. For items of rigging used in combination, the safe working load shall be that of the weakest item.

17.1.4 **Job-fabricated rigging hardware.** Use of job-fabricated rigging hardware is prohibited unless designed and certified by an engineer qualified in this field, and tested at twice the rated safe working load.

17.1.5 **Repair and maintenance.** The installation, maintenance, and repair of ropes, chains, slings, and rigging accessories shall be by the manufacturer or in accordance with the manufacturer's written instructions. Repaired slings and accessories shall be tested at twice their rated load prior to use.

17.1.6 **Inspection.** Frequent and periodic inspections should be made. Defective equipment shall be immediately removed from service.

a. *Frequent inspections.* Rigging equipment shall be inspected by the user prior to use on each shift.

b. *Periodic inspections.* Rigging equipment shall be inspected monthly by a competent person and a written record maintained. Inactive equipment shall be given a periodic inspection prior to use.

17.2 ALLOY STEEL CHAINS

17.2.1 **Safe working load.** The safe working load shall not exceed the rated capacities set forth in appendix L, table 2.

17.2.2 **Grade.** Only heat-treated alloy steel chains will be used in hoisting operations. Heat-treated alloy steel chain shall be marked on each link. Manufacturer's data should be consulted to interpret the markings.

17.2.3 **Identification.** Welded alloy steel chain slings shall have permanently-affixed durable identification tags stating size, grade, rated capacity, and sling manufacturer.

17.2.4 **Accessories.** Hooks, rings, links, or other attachments when used with alloy steel chains shall have a rated capacity at least equal to that of the chain. Job-made hooks, links, or makeshift fasteners formed from bolts, rods, etc., shall not be used.

17.2.5 **Impact loading.** Chains shall not be subjected to impact loading or jerking.

17.2.6 **Excessive wear.** Whenever wear at any point in any chain link exceeds that shown in the following table, the chain shall be removed from service.

Table 17-1. - Maximum allowable chain link wear.

Link diameter inch	Maximum allowable wear inch	Link diameter inch	Maximum allowable wear inch
9/32	3/64	1	3/16
3/8	5/64	1-1/8	7/32
1/2	7/64	1-1/4	1/4
5/8	9/64	1-3/8	9/32
3/4	5/32	1-1/2	5/16
7/8	11/64	1-3/4	11/32

17.3 WIRE ROPE AND WIRE ROPE SLINGS

17.3.1 **Safe working load.** The approximate safe working load for various specified sizes and classification of improved steel wire rope are set forth in appendix S.

17.3.2 **End fasteners.** Only commercial wire rope fittings shall be used. Wire rope clips shall be installed as specified in appendix S. Job-fabricated eye splices shall be made in accordance with the manufacturer's instructions and appendix S and tested prior to use. An eye splice shall have not less than three full tucks. When a wedge socket fastener is used, the dead or short end

of the rope shall either have a clip attached to it, be looped back and secured to itself by a clip, or have a short piece of rope secured to the dead end with wire rope clips. (See app. S.)

17.3.3 Protruding ends. Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

17.3.4 Hoisting rope. Except for end fasteners, wire rope used in hoisting, lowering, or pulling loads shall be continuous without knots or splices.

17.3.5 Prohibited fastenings. Eyes in wire rope bridle slings or bull wires shall not be formed by wire clips or knots. Use of wire rope clips to splice wire rope shall be in accordance with method described in appendix S. Fold back and pressed metal sleeve eye splices shall not be used on hoisting or suspension or sling ropes.

17.3.6 Spooling of rope. Wire rope shall be correctly overwound or underwound from right to left or left to right in accordance with the lay to avoid twisting, spreading, or overlapping on winch drums.

17.3.7 Sheave diameter. The ratio between the rope diameter and the drum or sheave diameter shall not be less than specified by the rope manufacturer. When not so specified, the ratio shall be in accordance with the more stringent appropriate ANSI Standards requirements. Drums, sheaves, and pulleys shall be smooth and free of defects which could damage the rope.

17.3.8 Sheave groove tolerance. Sheave groove tolerances shall be as recommended by the manufacturer of the sheave.

17.3.9 Lubrication. Wire rope shall be lubricated with manufacturer- approved lubricants at intervals warranted by the type of service.

17.3.10 Removal and replacement. Wire rope with one or more of the following defects shall be removed from hoisting or load-carrying service immediately:

- a. *Corrosion.* Corrosion from acids or alkalies resulting in pitting or loss of more than one-third of the original wire diameter.
- b. *Broken wire.*
 - 1. One or more valley breaks. (A valley break is a wire break occurring in the valley between two adjacent strands.)
 - 2. Six randomly spaced broken wires in one wire rope lay or three broken wires in one strand in one lay.
- c. *Abrasion.* Abrasion, scrubbing, flattening, or peening resulting in loss of more than one-third the original diameter of the outside wires.

d. *Kinking*. Kinking, crushing, bird caging, or other damage resulting in distortion of the rope structure.

e. *Heat damage*. Evidence of heat damage resulting from a torch, excessive friction, or contact with electrical wires.

f. *Reduction in diameter*. Reductions from nominal diameter or more than 3/64 inch for rope diameters up to and including 3/4 inch, of more than 1/16 inch for diameter 7/8 to 1-1/8 inches, or of more than 3/32 inch for rope diameters 1-1/4 to 1-1/2 inches.

g. See appendix S for additional information.

17.3.11 **Socket breaks**. When two or more wires are broken or rusted or corrosion is found adjacent to a socket or end fitting, the wire rope shall be resocketed or removed from service.

17.3.12 **Marking defective rope**. Wire rope removed from service due to defects shall be cut up and discarded or plainly marked as being unfit for load-bearing service.

17.3.13 **Hazardous location**. Running lines of stationary hoisting equipment located within 8 feet of the ground or working level shall be guarded, or the hazardous area enclosed or barricaded.

17.4 SLINGS

17.4.1 **Safe working loads**. The safe working loads of slings shall not exceed the rated capacities set forth in appendix L, tables 2 through 16. For types of slings not included in these referenced tables, the manufacturer's recommended safe working load for the specific angle of loading shall be followed, provided that a minimum safety factor of five is maintained, unless a higher factor of safety is required elsewhere in these standards.

17.4.2 **Protection**. Slings shall be protected from sharp, rough, or square corners by appropriate means in order to prevent damage to the strands, wires, or links. Proper storage shall be provided for slings when not in use to protect against damage.

17.4.3 **Removal from service**. Chain, wire rope, fiber, synthetic webbing, metal mesh slings, and sling hooks shall be routinely inspected and removed from service when wear exceeds that set forth in appendix L.

17.5 MANILA AND SYNTHETIC FIBER ROPE

17.5.1 **Safe working load**. The safe working loads for manila (No. 1 grade) and synthetic fiber rope and slings shall not exceed the rated capacities as set forth in appendix L, tables 10 through 16. When not specifically identified in the referenced tables, a minimum safety factor of five shall be used to compute the safe working load.

17.5.2 Splices. In addition to the manufacturer's recommendations, the following minimum requirements shall be met in splicing fiber rope.

- a. *Manila rope.* Eye splices shall contain at least four full tucks, and short splices shall contain at least six full tucks with three on each side of the centerline of the splice.
- b. *Synthetic fiber.* Eye splices shall contain at least four full tucks, and short splices at least eight full tucks with four on each side of the centerline of the splice.
- c. *Strand end tails.* For fiber ropes under 1 inch in diameter, the tails shall project at least six rope diameters beyond the last full tuck. For ropes 1 inch and larger, the tails shall project at least 6 inches beyond the last full tuck. The required length of strand and tails may be tapered and spliced into the body of the rope using at least two additional tucks.
- d. *Eye of splice.* The eye shall be sufficiently large to provide an angle of not greater than 60 degrees at the splice when the eye is placed over the load or support.
- e. *Knots.* Use of knots is prohibited.

17.5.3 Electrical hazard. Only nonconductive synthetic fiber rope shall be used in the proximity of energized conductors or equipment, including handlines for work on electrical facilities.

17.5.4 Care of fiber ropes. Proper care shall be given fiber ropes to maintain them in safe condition. Fiber ropes that have been subjected to acids, alkalies, freezing, or excessive heat shall not be used for load-carrying purpose. Fiber rope shall be protected from abrasion by padding when it is drawn over square corners, or sharp or rough surfaces.

17.6 SYNTHETIC-WEBBED SLINGS

17.6.1 Marking. Synthetic-webbed slings shall be marked or coded to indicate manufacturer's name, type of material, and the rated capacity for the type of hitch.

17.6.2 Care and Maintenance.

- a. *Webbing.* Synthetic webbing shall be of uniform thickness and width and selvage edges shall not be split from the webbing's width.
- b. *Fittings.* Fittings shall be of a minimum breaking strength equal to that of the sling and free of all sharp edges that could in any way damage the webbing.
- c. *Attachments.* Stitching shall be the only method used to attach fittings and form eyes. The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

d. *Storage and use.* Nylon web, polyester and polypropylene web slings and web slings with aluminum fittings shall not be used or stored where caustic fumes, vapors, sprays, mists, or liquids are present.

e. *Temperature.* Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 180 °F. Polypropylene web slings shall not be used at temperatures in excess of 200 °F.

17.6.3 Removal from service. Synthetic web slings shall be immediately removed from service if any of the following conditions are present:

- a. Acid or caustic burns
- b. Melting or charring of any part of the sling surface
- c. Snags, punctures, tears, or cuts
- d. Broken or worn stitches
- e. Distortion of fittings
- f. Appearance of wear indicators

17.7 SHACKLES AND HOOKS

17.7.1 Shackles

a. *Safe working load.* Table 17-2 shall be used to determine the safe working loads of shackles. Higher safe working loads recommended by the manufacturer are acceptable for specific identifiable products if a minimum safety factor of five or the more stringent safety factors specified elsewhere in these standards are maintained.

b. *Hoisting.* Shackles used for hoisting shall be of forged alloy steel, and shall be of the locking or secured-pin type.

c. *Wear or damage.* Shackles that are bent, distorted, or worn in the crown or pin by more than 10 percent of their original diameter shall be removed from service.

Table 17-2. - Safe working loads for shackles
(2,000-lb tons)

Material size inch	Pin diameter inch	Safe working loads tons
1/2	5/8	1.4
5/8	3/4	2.2
3/4	7/8	3.2
7/8	1	4.3
1	1-1/8	5.6
1-1/8	1-1/4	6.7
1-1/4	1-3/8	8.2
1-3/8	1-1/2	10.0
1-1/2	1-5/8	11.9
1-3/4	2	16.2
2	2-1/4	21.2

17.7.2 Hooks

- a. *Requirement.* Manufacturing, testing, inspecting, and use of hooks will conform to the more stringent requirements contained in ANSI B30.10, "Hooks," or manufacturer specifications and recommendations, or these standards.
- b. *Safe working load.* The manufacturer's recommendation shall be followed in determining the safe working load for the specific size and type of hook used. Hooks for which no manufacturer's recommendation are available shall be tested at twice the intended safe working load prior to use. A record of the dates and results of the tests shall be maintained.
- c. *Hoisting hooks.* Hoisting hooks, as opposed to sling and choker hooks, shall be of forged alloy steel and shall be stamped with their safe working loads. Hoisting hooks should preferably be used with swivels and headache balls and shall be equipped with safety keepers. (Refer to para. 18.1.13.)

Section 18

HOISTING EQUIPMENT, PILEDRIVERS, AND CONVEYORS

18.1 HOISTING EQUIPMENT---GENERAL REQUIREMENTS

18.1.1 **Requirement.** The installation, set-up, operation, maintenance, inspection, and testing of cranes and hoisting equipment will comply with the more stringent of these standards, applicable ANSI Standards, or recommendations of the equipment manufacturer. Machines covered by this section will not be placed in operation unless the manufacturer's operating instructions or manual, and the owner's maintenance and inspection records are available for review by the operator. When operating instructions and limitations are unavailable from the manufacturer, they shall be developed by a registered professional engineer, competent in the field.

18.1.2 **Posting.** Rated load capacities, operating speeds, special warnings, and all other information required by the manufacturer and/or professional engineer and applicable ANSI Standard shall be posted where clearly visible to operator(s) of hoisting equipment. The load capacities and instructions shall be reviewed with and adhered to by the operator of the equipment. Except for testing, hoisting equipment shall not be loaded in excess of posted maximum loads considering boom angle, outrigger support, and other limiting factors.

18.1.3 **Modification and reconfiguration.** Modification, additions, or repairs which affect the structural competence, capacity, or safe operation of the equipment or system shall not be made without the manufacturer's written approval or approval of a professional engineer competent in the field.

18.1.4 **Performance inspections and tests.** Prior to initial onsite operation, at 12-month intervals, following major repairs, including rope replacement, or modification, and after changes to machine configuration, power cranes, aerial lifts, derricks, cableways, and other hoists and hoisting systems shall be thoroughly inspected and satisfactorily complete a performance test that demonstrates the equipment's ability to safely handle and maneuver rated loads. The annual inspection shall be conducted by a competent person and shall be documented in addition to the performance test. These tests and inspections will be conducted onsite in the presence of a Reclamation representative in accordance with specific requirements set forth herein, elsewhere in this section, and as follows:

- a. Initial and periodic performance inspections and tests shall be conducted onsite after the crane hoist or hoisting system has been assembled or reassembled and rigged for operation.

b. Crawler, locomotive, and wheel-mounted cranes shall be performance inspected and tested in accordance with the more restrictive requirements of this paragraph, subsection 18.2, and appendix U.

c. All other cranes, hoists, derricks, cableways, specialized hoisting equipment, installations, and systems described in this section shall be onsite performance inspected and tested under the direct supervision of the manufacturer and/or responsible design engineer or their designee. The inspection(s) and test(s) shall conform to the more restrictive requirements of this paragraph, other applicable paragraphs of this section, or referenced standards. Following inspection(s) and test(s) and prior to placing the equipment or system in service, the manufacturer and/or responsible design engineer shall provide the following:

1. A comprehensive report detailing the initial performance and testing procedure, findings, and recommendations.
2. A copy of recommended periodic inspection, testing, and maintenance requirements, and operating and rigging instructions.
3. A written certification that the inspected and tested equipment and system(s) meet or exceed the specific requirements of this section and referenced standards and the equipment and system(s) are capable of safely performing the intended service.

d. All cranes, hoisting equipment and systems described in subparagraph "c" permanently installed under a Reclamation contract and not used for construction purposes are exempt from the requirement of paragraph 18.1.4. Such equipment shall be inspected and tested in conformance with the more stringent of the requirements contained in the contract specifications or the applicable standards referenced in this section.

18.1.5 Daily inspection and maintenance. Hoisting equipment shall be inspected prior to use at the start of each shift by a competent person(s) to determine whether or not it is in safe operating condition. Any damage or deficiencies shall be corrected prior to use. Provision shall be made for routine lubrication and maintenance of all hoisting equipment. Written records of all inspections, deficiencies, and repairs shall be maintained.

18.1.6 Operators. Operators of mobile cranes, cableways, cab-operated bridge cranes, derricks, mobile excavators, loaders and similar equipment when used to hoist materials, and aerial lifts shall be examined and provided with a physician's certificate stating that he/she is physically qualified to safely operate the hoisting equipment to which he/she is assigned. At least once a year, he/she shall undergo a physical examination and obtain a physician's certificate of physical fitness. Operators shall not work or be at the jobsite over 12 hours in any 24-hour period.

Only operators qualified by training or experience shall be authorized to operate cranes or hoisting equipment. Operators with less than 5 years experience shall receive at least 40 hours

of on-the-job training under the direct supervision of a qualified operator before being considered qualified to operate hoisting equipment. The training program shall not be conducted where other employees may be exposed to hazards. Experienced operators unfamiliar with the specific equipment to be operated shall receive an adequate orientation to the specific equipment which will include review of manufacturer's operating manual and hands-on practice.

18.1.7 Operation. The operator shall be responsible for those operations under his/her direct control. Whenever there is any doubt as to safety, the operator shall have the authority to stop or to refuse to handle loads until safety has been assured.

- a. When hoisting equipment is in operation, the operator shall not be permitted to perform any other work nor shall he/she leave the operator's position while a load is suspended in the air.
- b. In the absence of crane manufacturers' instructions regarding maximum permissible wind speeds for operation of cranes, operations shall be shut down when wind speeds exceed 25 mph.
- c. If the visibility of the operator is impaired by dust, darkness, snow, or rain, the crane operation shall be shut down unless steps are taken to compensate for the lack of visibility.
- d. Except during performance tests, no loads greater than the rated load of the crane will be lifted. At no time will the outrigger pads on wheel-mounted cranes, or any portion of the tracks on track-mounted cranes be permitted to leave the ground when handling the load.

18.1.8 Braking. A braking system capable of stopping, lowering, and holding a load of at least 110 percent of the rated maximum capacity shall be provided on all hoisting equipment.

18.1.9 Load drums. Load drums on load-hoisting equipment shall be equipped with dogs, pawls, or other positive holding devices. At least two full wraps of line shall be maintained on hoisting drums.

18.1.10 Riding loads. Except as provided in the following and in subsections 13.21 and 18.12, no person shall be permitted to ride loads, blocks, buckets, hooks, scaffolding, boatswain's chairs, cages, or other type devices attached to hoist lines, booms, or attachments of any crane, derrick, or materials hoist. Designated maintenance personnel may ride the carriage service platform of a cableway to perform inspection testing or maintenance.

18.1.11 Boom stops. Cranes or derricks with cable-supported booms, except draglines, shall have a device attached between the gantry or A-frame and boom chords to limit the elevation of the boom. The device shall control the vertical motions of the boom with gradually increasing resistance from 83 degrees or less, until completely stopping the boom at not over 87 degrees above the horizontal.

18.1.12 **Hoisting ropes.** Hoisting ropes shall be installed and maintained in accordance with the manufacturer's recommendations. Rotation-resistant ropes shall not be used for hoisting unless specified by the manufacturer and then only in accordance with instructions and increased design safety factors required by the manufacturer and/or respective national standards.

18.1.13 **Hooks.** Hooks and shackles used on hoisting equipment shall meet requirements of subsection 17.7. Hooks shall be equipped with approved safety keepers.

18.1.14 **Boom length indicators.** Hoisting equipment with telescopic or extendible booms shall have an indicator that shows the boom length from minimum to maximum and shall be visible to the operator from his/her position at the controls.

18.1.15 **Rigging.** Loads shall be safely rigged by a competent person.

18.1.16 **Safe clearance.** Unless barricaded, adequate clearance shall be maintained between moving and rotating parts of a crane and other fixed objects in order to permit safe passage of persons.

18.1.17 **Signal system.** A uniform signal system, as set forth in subsection 9.5, shall be used in the operation of cranes, derricks, and hoists. Hand signals shall conform to those illustrated in Appendix F, "Hand Signals for Cranes and Hoisting Equipment."

18.1.18 **High-voltage lines.** Specific requirements pertaining to operation of cranes and other equipment near high-voltage lines are set forth in subsection 12.10.

18.1.19 **Ropes, slings, chains, accessories.** Ropes, slings, chains, and accessories shall meet the more stringent of section 17 or the manufacturer's specifications. See rigging manual referenced in subsection 17.1 for additional information.

18.1.20 **Taglines.** Taglines for controlling loads shall be used whenever necessary for protection of personnel, equipment, and structures.

18.2 CRAWLER-, LOCOMOTIVE-, AND WHEEL-MOUNTED CRANES

18.2.1 **Requirement.** In addition to the requirements set forth in these subsections and 18.1 and 19.7 and appendix U, crawler-, locomotive-, truck-, and wheel-mounted cranes shall conform to the standards in the current edition of ANSI B30.5; side boom wheel or crawler tractors shall conform to the requirements of the Society of Automotive Engineers (SAE) J743 and ANSI B30.14; and hydraulic cranes shall conform to the standards set forth in ANSI B30.5 and PCSA Standard No. 4.

18.2.2 **Boom angle indicator.** Mobile cranes shall be equipped with a boom angle or radius indicator located within the operator's view.

18.2.3 Anti-two-blocking device. All cranes with telescoping booms and all cranes used in personnel hoisting operations shall be equipped with a two-block damage prevention feature or an anti-two-blocking device. Two-block damage prevention features must be capable of preventing damage to the crane or hoist line in case of a two-block condition. Anti-two-blocking devices shall have automatic capabilities for controlling functions that may cause a two-block condition. A two-block prevention feature or a anti-two-blocking device which sounds an alarm only is not acceptable.

18.2.4 Level indicator. Means shall be provided for the operator to visually determine the levelness of the crane.

18.2.5 Jib stops. In addition to boom stops, jibs shall have a positive stop installed to prevent overtopping.

18.2.6 Cab windows. Windows installed in crane cabs shall be safety glass or equivalent that introduces no distortion which will interfere with the safe operation of the crane.

18.2.7 Audible warning device. Power cranes shall be equipped with an audible warning signal device that can be heard above usual construction noise levels. Backup alarm meeting requirements of paragraph 19.7.3 shall be installed on all mobile cranes.

18.2.8 Barricades. The rear-swing radius area of rotating superstructures of mobile cranes shall be barricaded in a manner that physically prevents persons or equipment from entering the danger zone.

18.2.9 Securing booms. When not in use, crane booms shall be lowered to the ground or otherwise secured to prevent displacement by wind or other outside forces.

18.2.10 Performance inspection and testing. Performance inspections and testing shall be conducted and recorded in accordance with requirements of paragraph 18.1.4.

18.2.11 Fire extinguisher. The cab shall be provided with a fire extinguisher rated at least 2-A:40-B:C.

18.3 PORTAL, TOWER, AND PILLAR CRANES

18.3.1 Requirement. In addition to the requirements set forth in this subsection and subsection 18.1, portal, tower, and pillar cranes shall conform to the applicable standards in the current edition of ANSI B30.4, "Safety Standards for Portal, Tower and Pillar Cranes," and ANSI B30.3, "Hammerhead Tower Cranes."

18.3.2 Design. Crane installation and equipment shall be designed by the manufacturer and/or a professional engineer competent in the field.

18.3.3 Operating cabs. The operator's cab of a tower crane, either tower mounted or remote from the tower, shall meet the following minimum requirements:

- a. *Vision.* The cab shall be designed and constructed to provide the operator a clear and unrestricted view of the load and boom point and as clear a view as possible of the jobsite.
- b. *Windows.* The windows shall be constructed of safety glass or equivalent and designed to provide ventilation.
- c. *Lock.* The cab shall be equipped with a lock to prevent unauthorized entry unless the control unit can be separately locked.
- d. *Access.* The cab shall be provided with a means of safe access for the operator. All walking surfaces to and from the cab shall be of an anti-slip type and protected with guardrails.
- e. *Wiper and defroster.* The windshield shall be equipped with a windshield wiper and, in cold climates, a heater and defroster shall be installed in the cab.
- f. *Fire extinguisher.* The cab shall be provided with at least a 2-A:40-B:C unit fire extinguisher.

18.3.4 Operating controls. All controls shall automatically return to neutral when released. Each control shall be plainly marked to indicate its function and shall be in easy reach of the operator. The main switch shall be lockable and within reach of the operator.

18.3.5 Brakes. All brakes on the crane shall be designed so that the brake will be automatically applied when there is loss of power and cannot be released until power has been restored. The brake on the slewing drive shall be designed so that the jib will weather-vane when the wind pressure exceeds the pressure specified by the manufacturer.

18.3.6 Boom stops. Luffing boom tower cranes shall be equipped with a shock-absorbing boom stop of a type which disengages the boom hoist motor and physically stops the boom at a predetermined maximum angle.

18.3.7 Limit switches. Tower cranes of every configuration shall be equipped with the limit switches described in the following:

- a. A hook-height limit switch that causes the hoist drum to stop whenever the load hook reaches a predetermined maximum height below the head block.
- b. Trolley limit switches that stop the trolley motion whenever the trolley reaches a predetermined "out" or maximum "in" position.

- c. An overload limit switch that causes the hoist drum to stop whenever the load being hoisted exceeds the maximum rated load for any radius or boom angle or whenever the overturning moment exceeds the rated load moment.

18.3.8 Boom angle indicator. A boom angle indicator shall be installed on all machines having booms capable of moving in the vertical plane.

18.3.9 Audible warning. Tower cranes shall have an audible warning device controlled by the operator.

18.3.10 Maintenance access. Safety lines with runners for attachment of safety belt lanyards shall be fitted to tower crane jibs, and safety platforms shall be installed on the trolleys of saddle jibs to afford safe inspection and maintenance.

18.3.11 Trolley radius markers. Trolley radius markers clearly visible from the cab shall be installed on the jib.

18.3.12 Track-mounted tower cranes. Track-mounted tower cranes shall have limit switches and stops or buffers installed at each end of the tracks. The wheel trucks shall be equipped with rail sweeps extending below the top of the rail.

18.3.13 Wind velocity device. A wind-indicating device shall be provided which will give a visible or audible alarm to the crane operator when wind speeds exceed 25 mph or a lower speed if recommended by the crane manufacturer.

18.3.14 Performance testing and inspections. Portal, tower, and pillar cranes, installations, and equipment shall be performance inspected and tested in accordance with the more stringent requirements of paragraph 18.1.4, the manufacturer, and/or ANSI B30.4 and ANSI B30.3 as applicable.

18.4 OVERHEAD, GANTRY, MONORAILS, AND UNDERHUNG CRANES

18.4.1 Requirement. In addition to requirements set forth in this subsection and subsection 18.1, overhead and gantry cranes shall conform to requirements contained in the current edition of ANSI B30.2, "Safety Code for Overhead and Gantry Cranes," and monorails and underhung cranes shall conform to the requirements contained in the current edition of ANSI B30.11, "Monorail Systems and Underhung Cranes."

18.4.2 Design. Crane installations and equipment shall be designed by the manufacturer or a professional engineer competent in the field.

18.4.3 Support. The crane runways and supporting structures shall be designed to withstand the loads and forces imposed by the crane plus the maximum rated load.

18.4.4 **Crane access.** Safe access to the cab and/or bridge walkway shall be provided by a fixed ladder, stairs, or platform with no step or gaps exceeding 12 inches. Fixed ladders and stairways shall be in compliance with the requirements set forth in subsection 13.14.

18.4.5 **Platforms and walkways.** Maintenance platforms and walkways protected by standard guardrails and toeboards, and means of safe access shall be installed on the trolley and bridge. Where it is impractical to install platforms and walkways, safety lines with runners for attachment of safety belt lanyards shall be installed to afford safe inspection and maintenance.

18.4.6 **Limit switches and rail stops.** Rail-mounted cranes, trolleys, and bridges shall be equipped with both switches and rail stops or buffers at each end of the tracks.

18.4.7 **Rail sweeps.** Track-mounted cranes, bridges, and trolleys shall be equipped with rail sweeps extending below the top of the rail and effective in all directions of travel.

18.4.8 **Audible alarm.** Except for floor-operated cranes, a gong or other effective audible warning signal shall be installed on cranes with power- traveling mechanisms.

18.4.9 **Hook limit switch.** A hook-height limit switch that causes the hoist drum to stop whenever the load hook reaches a predetermined maximum height below the headblock shall be installed on overhead and gantry cranes.

18.4.10 **Operating controls.** All controls shall automatically return to neutral when released. Each control shall be plainly marked to indicate its function. A main power switch capable of being locked in the open position shall be within reach of the operator.

18.4.11 **Brakes.** All brakes shall be designed so that the brake will be automatically applied when there is a loss of power and not release until power has been restored.

18.4.12 **Fire extinguisher.** A fire extinguisher of 2-A:40-B:C rating or greater shall be mounted in the cab or in close proximity to the operator's position.

18.4.13 **Performance tests and inspections.** Overhead, gantry, monorail, and underhung cranes permanently installed under a Reclamation contract and not used for construction purposes shall be tested and inspected in accordance with the conditions and requirements set forth in the contract specifications. Such tests and inspections shall be conducted in the presence of the design engineer or his/her designee. Overhead, gantry, monorail, and underhung cranes shall be performance inspected and tested in accordance with requirements of paragraph 18.1.4.

18.5 DERRICKS

18.5.1 **Requirement.** Derricks, in addition to the requirements set forth in this subsection and subsection 18.1 shall conform to the requirements contained in the current edition of ANSI B30.6, "Safety Standards for Derricks."

18.5.2 **Design.** Derrick installations and equipment shall be designed by a professional engineer competent in the field.

18.5.3 **Foundation.** Derricks shall set on foundations designed and constructed to support the weight of the crane plus the maximum rated load.

18.5.4 **Boom angle indicator.** A boom angle or radius indicator shall be provided within the operator's view.

18.5.5 **Fire extinguisher.** A fire extinguisher of 2-A:40-B:C rating or greater shall be mounted at the operator's station.

18.5.6 **Performance inspections and tests.** Derrick installation and equipment shall be performance inspected and tested in accordance with requirements of paragraph 18.1.4

18.6 FLOATING CRANES AND DERRICKS

18.6.1 **Requirement.** In addition to the requirements set forth in this subsection and subsection 18.1, floating cranes and derricks shall conform to the requirements contained in the current edition of ANSI B30.8, "Safety Code for Floating Cranes and Floating Derricks."

18.6.2 **Design.** All floating cranes and derricks shall be designed and certified by the manufacturer or by a marine engineer competent in the field.

18.6.3 **Fire extinguisher.** A fire extinguisher of 2-A:40-B:C or greater shall be mounted at the operator's station.

18.6.4 **Load rating chart.** When load ratings are reduced to compensate for "barge list," a new rating chart shall be provided. Barge-mounted cranes designed and constructed as a unit shall be rated by the manufacturer. All other barge-mounted cranes shall be of sufficient size to limit the "list" under maximum load to 5 degrees.

8.6.5 **Wave action.** Crane operation shall be suspended when significant wave action exists.

18.6.6 **Truck and crawler cranes.** Truck and crawler cranes, when used as floating cranes, shall be securely attached to the barge. However, when the stability of the barge is not a factor, limited travel may be permitted providing positive travel stoplogs or equivalent are provided and the operation is approved.

18.6.7 **Performance inspections and tests.** Floating crane and derrick installation and equipment shall be performance inspected and tested in accordance with requirements of paragraph 18.1.4.

18.7 OVERHEAD HOISTS

18.7.1 **Requirement.** The installation, operation, and maintenance of overhead hoists shall be in compliance with the more stringent provision of this section and ANSI B30.16, "Overhead Hoists (Underhung)."

18.7.2 **Design.** Hoists and hoist suspensions and anchorages shall be designed by the manufacturer or a professional engineer competent in the field.

18.7.3 **Safe working load.** The safe working load, as determined by the manufacturer, shall be indicated on the hoist and shall not be exceeded.

18.7.4 **Support.** The supporting structure shall have a safe working load exceeding that of the hoist plus the maximum rated loading with a safety. The support shall provide unobstructed movement of the hoist and load. It shall also permit the operator to stand clear of the load in all hoisting positions.

18.7.5 **Limit switch.** Power-operated overhead hoists shall be equipped with a limit switch.

18.7.6 **Emergency stop switch.** In addition to the regular operating controls, power-operated overhead hoists shall have a switch within the operator's reach which will cut off the power supply in case of a malfunction.

18.7.7 **Brakes.** Except for hand-powered hoists, all overhead hoists shall be equipped with brakes which apply automatically when the controls are in neutral.

18.7.8 **Air-operated hoists.** Air hoists shall be connected to an air supply of sufficient capacity and working pressure to safely operate the hoist with maximum load.

18.7.9 **Hand-powered hoists.** Hand-powered hoists shall be worm-gear-driven or equipped with a pawl or ratchet system permitting continuous effective control and braking reliability.

18.7.10 **Performance inspections and test.** Overhead hoists installations and equipment shall be performance inspected and tested in accordance with requirements of paragraph 18.1.4.

18.8 CABLEWAYS AND HIGHLINES

18.8.1 **Requirement.** In addition to the requirements of this subsection, cableways and highlines shall comply with the applicable installation, testing, operation, and maintenance requirements set forth in subsection 18.1, and shall conform to the standards in the current edition of ANSI/ASME B30.19 "Cableways."

18.8.2 **Design and installation.** Cableways and highlines shall be designed by a professional engineer qualified in the field, and installed and operated in accordance with the design

drawings, specifications, and operating, maintenance, and inspection instructions furnished by the engineer.

18.8.3 Inspection and maintenance. A daily inspection shall be made of all cableway components and provision made for daily routine maintenance and lubrication.

18.8.4 Cableway log. A log shall be maintained for each cableway or highline in which inspections, lubrication, maintenance, and repair activity are recorded. The log shall also include operating time, downtime, and be signed by the employee responsible for performing the maintenance or repair work. The log shall be available for review by the COR or the office head.

18.8.5 Signal system. At least two systems of communication and control shall be continuously maintained between the operator and the signalperson. One or both of the systems shall provide voice communication by telephone or radio. Use of lights or bells may be substituted for one of the systems. When the dual system is not functioning properly, the load suspended from the cableway may be delivered, but no further load rigged until both communication systems are functioning.

18.8.6 Control consoles. During operation of the cableway, only the operator(s) shall be permitted in the control console room. The console room windows shall be safety glass that introduces no distortion that interferes with the safe operation of the cableway. The room shall be heated and/or air-conditioned as necessary for the operator's comfort.

18.8.7 Operating controls. All controls shall when released automatically return to neutral and set the brakes. Each control shall be plainly marked to indicate its function and in easy reach of the operator.

18.8.8 Cableway platforms and carriages. Cableway inspection platforms, moving and stationary, shall be provided with standard guardrails and toeboards. Open areas on carriages and moving platforms shall be enclosed with wire mesh to reduce the hazard from falling objects.

18.8.9 Concrete buckets. Concrete buckets shall be designed with a safety device which will prevent accidental opening of the bucket while in transit to the discharge site. Buckets shall be constructed in a manner which prevents aggregate from lodging on any part of the bucket and shall comply with the requirements of paragraph 25.1.8.

18.8.10 Riding cableways. Refer to paragraph 18.1.10.

18.8.11 Track-mounted towers. Track-mounted cableway towers or structures shall be equipped with both limit switches and rail stops or buffers at each end of the tracks. The wheel trucks shall be equipped with track or rail sweeps extending below the top of the rail and effective in all directions of travel. When two or more towers operate on the same track, an automatic control system shall be installed to prevent the towers from colliding.

18.8.12 Performance inspections and tests. Cableways and highlines shall be performance tested and inspected under the direction of the design engineer or his/her designee in accordance with the requirements of this paragraph and 18.1.4. The cableways and highlines shall be performance tested with a test load weighing 110 percent of the rated load. The test load shall be raised and lowered through hoisting limits. Braking systems will be tested by stopping and holding the test load for 5 minutes, at the two maximum hoisting limits and at a midpoint position. All raising, lowering, and braking tests will be conducted at three trolley travel positions including both limits and midpoint of travel. Further, the three travel position tests shall be conducted at both maximum tower travel positions if movable head or tail towers are utilized. All limit switches or devices shall be dynamically tested at full travel speed without load.

18.9 ELEVATORS

18.9.1 Requirement. Whenever practical, depending on the nature and size of the job, permanent passenger and/or freight elevators should be installed and used. Permanent elevators shall be designed, constructed, tested, inspected, and maintained in accordance with the current editions of ANSI A17.1, "Elevators and Escalators," and ANSI A17.2, "Inspectors' Manual for Elevators and Escalators." Elevator installations shall be designed, installed, and tested under the direction of the manufacturer or a professional engineer competent in the field. Following installation, elevators shall be inspected and tested and certified in accordance with referenced standards and paragraph 18.1.1 prior to use and once each year thereafter.

18.10 PERSONNEL HOISTS

18.10.1 Requirement. Personnel hoists shall be constructed, installed, tested, operated, and maintained as set forth in the current edition of ANSI A10.4, "Safety Requirements for Personnel Hoists," and the requirements of this subsection and subsection 18.1.

18.10.2 Design and installation. The contractor shall comply with the manufacturer's drawings, specifications, and limitations in the installation and operation of personnel hoists. All personnel hoists shall be designed by a registered professional engineer competent in the field and fully cognizant of the applicable ANSI Standards.

18.10.3 Posting. Rated load capacities, recommended operating speeds, and special hazard warnings shall be posted on cages, platforms, and at the operator's station.

18.10.4 Hoistway enclosure. Hoist towers installed outside buildings or structures shall be enclosed for the full height of the side or sides used for entrance or exit to the building or structure. The other sides shall be enclosed to a height of at least 10 feet at the lowest landing. Sides of the tower adjacent to floors or scaffold platforms shall be enclosed to a height of 10 feet above the level of such floors or scaffolds. Towers inside buildings or structures shall be enclosed on all four sides throughout the full height.

18.10.5 Tower anchorage. Towers shall be anchored to the structure at intervals not exceeding 25 feet. In addition to tie-ins, a series of guys shall be installed. Where tie-ins are not practical, the tower shall be anchored by wire rope guys at least 0.5 inch in diameter securely fastened to anchorages to ensure stability.

18.10.6 Cage enclosure. Cages shall be fully enclosed on all sides and the top, except sides used for entrance which shall have car gates or doors.

18.10.7 Entrance doors. A door or gate shall be provided at each entrance to the cage, designed to cover the full height and width of the cage entrance opening.

18.10.8 Door interlocks. Doors or gates shall be provided with interlocks which will not permit movement of the cage unless the door or gate is fully closed.

18.10.9 Overhead protection. Overhead protection of 2-inch planking, 0.75-inch plywood, or other material of equivalent strength shall cover the top of the cage.

18.10.10 Overspeed safety device. The cage shall be equipped with an overspeed safety device which will stop and hold the cage plus the maximum rated load when the governor tripping speed is exceeded or the hoist rope fails.

18.10.11 Brakes. The hoist shall be equipped with two independent braking systems. One shall be an automatic-type system that will be applied when the controls are in neutral or in event of a power failure. In addition, a manually operated braking system shall be attached to the hoist drum, and shall be capable of stopping and holding at least 125 percent of the rated load in any position.

18.10.12 Power-up and power-down. The hoist power unit shall be designed to provide power-up and power-down through the gears at all times. Also refer to paragraph 18.10.11.

18.10.13 Controls. On manually controlled hoists, the controls shall return to the neutral or stop position when pressure is removed from the control lever.

18.10.14 Maximum speed. The speed of the cage shall not exceed 200 feet per minute.

18.10.15 Travel limit stops. Hoists shall be equipped with approved limit switches which will automatically cause the cage to stop at the top and bottom limits of travel.

18.10.16 Hoist ropes. Hoist wire ropes shall meet the following minimum requirements:

- a. *Minimum number.* Drum hoists shall have at least two hoisting ropes, and traction hoists shall have at least three hoisting ropes.
- b. *Safety factor.* Hoisting ropes shall have the following minimum safety factor, but in no event shall they be less than 0.5 inch in diameter.

<u>Rope speed</u> <u>ft/min</u>	<u>Minimum</u> <u>safety factor</u>
0-100	8.00
101-125	8.10
126-150	8.25
151-175	8.40
176-200	8.60
201-225	8.75
226-250	8.90
251-300	9.20
301-350	9.50
351-400	9.75
401-500	10.25
501-600	10.70

18.10.17 **Emergency stop switch.** An emergency stop switch shall be installed in the cage and marked "STOP."

18.10.18 **Maintenance access.** Safe accessways shall be provided for inspection and maintenance of hoist towers and equipment.

18.10.19 **Bridge tower construction.** Personnel hoists used in bridge tower construction shall be designed by a professional engineer and erected under the supervision of an engineer competent in the field. These hoists shall be inspected at least weekly and whenever exposed to winds exceeding 35 miles per hour.

18.10.20 **Wire rope.** Hoisting rope shall be inspected daily and removed from service when any of the conditions described in paragraph 17.3.10 exist.

18.10.21 **Signals.** Personnel hoists operated by a hoisting engineer shall be controlled by a radio, or a visual and audible electrically operated signal system installed between the operator and each cage access point.

18.10.22 **Performance inspecting and testing.** Personnel hoist shall be performance tested, inspected, and certified under the direction of the design engineer or his/her designee prior to placing the hoist in service and annually thereafter. The tests shall be conducted in accordance with ANSI A10.4, "Safety Requirements for Personnel Hoists," and paragraph 18.1.4. A comprehensive report detailing test and inspection procedures and results will be maintained.

18.11 MATERIAL HOISTS

18.11.1 **Requirement.** Material hoists shall be constructed, installed, tested, operated, and maintained as set forth in the latest edition of ANSI A10.5, "Safety Requirements for Material Hoists," and the requirements of this subsection and subsection 18.1. Material hoist

installations shall be designed by the manufacturer or a professional engineer competent in the field.

18.11.2 **Posting.** Operating rules including signals, line speeds, loading, etc., shall be posted at the operator's station and on the cage frame or crosshead.

18.11.3 **Riding.** No person shall be permitted to ride a material hoist except for the purpose of inspection and maintenance. Each hoist cage or platform shall be conspicuously posted **"NO RIDERS ALLOWED."**

18.11.4 **Hoistway entrances.** Entrances to the hoistway shall be protected by substantial gates or bars installed the full width of the landing entrance. Entrance bars and gates shall be painted with diagonal contrasting colors such as black and yellow stripes. Bars shall not be less than 2- by 4-inch wood, or equivalent, located not less than 36 inches nor more than 42 inches above the floor. They shall be located at least 2 feet from the hoist and equipped with a latching device.

18.11.5 **Overhead protection.** The top of the cage or platform shall be protected by 2-inch planking, 0.75-inch plywood, or material of equivalent strength.

18.11.6 **Tower enclosures.** Hoist towers may or may not be enclosed on all sides. Whichever alternative is chosen, the following requirements shall apply:

a. *Enclosed.* When a hoistway or tower is enclosed, it shall be enclosed on all sides for its entire height with 0.5-inch wire mesh screen, No. 18 U.S. gauge or equivalent, except at access points.

b. *Open sides.* When the hoist tower is not enclosed, the hoist cage or platform shall be totally enclosed on all sides between the floor and the protective top with 0.5-inch wire mesh screen, No. 14 U.S. gauge or equivalent. The hoist cage or platform enclosure shall include the required gates for loading and unloading. An enclosure at least 6 feet high shall be installed on the unused sides of the hoist tower at ground level.

18.11.7 **Operator's station.** The operator's station shall be protected by overhead planking not less than 2 inches thick, or material of equivalent strength.

18.11.8 **Towers and shaftways.** Towers and shaftways shall be designed by a professional engineer and shall have a safety device capable of stopping and holding the platform with maximum load in event of a cable failure.

18.11.9 **Tower support.** Towers shall rest on solid foundations, be plumb and well guyed, or otherwise anchored in 4 directions at the top and at least every 30 feet in height.

18.11.10 **Hinged roof.** The car or platform roof may be hinged to accommodate long material.

18.11.11 **Electric hoists.** Electric hoists shall be provided with an automatic motor brake to automatically stop and hold the load in case of a power failure.

18.11.12 **Operating restrictions.** Not more than one cage, bucket, or hoist platform shall be operated at the same time by one hoisting machine or by one operator.

18.11.13 **Hoisting machines.** Hoisting machines shall be designed and installed to raise and lower the maximum rated load plus the weight of equipment and ropes and shall incorporate the following features:

a. *Brakes.* The brakes shall be capable of stopping and holding 125 percent of the rated hoisting capacity under all operating conditions.

b. *Mechanical brakes.* Mechanical brakes shall be installed to stop movement of the hoist drum and shall be equipped with a positive acting device that will hold the brake in the engaged position.

c. *Ratchet and pawl.* Friction-clutch-driven winding drum hoisting machines shall be equipped with an effective pawl and ratchet capable of holding the rated load capacity when it is suspended.

d. *Controls.* All controls shall when released automatically return to neutral and set the brake. Each control shall be plainly marked to indicate its function and be in easy reach of the operator.

18.11.14 **Position indicator.** A positive system shall be used to indicate when the hoist car or platform has reached specific locations including the top and bottom landings.

18.11.15 **Signal system**

a. *Hand signals.* Hand signals may be used on a single drum hoist when the hoist tower does not exceed 50 feet in height and the signals are clearly visible to the operator at all times.

b. *Electrical communication.* A closed-circuit electrical communication system shall be used on all other material hoist installations. The system shall be a two-way system with a speaker located at the hoist operator's station and at each landing. The hoist operator shall be able to communicate by voice to and from each station.

18.11.16 **Fire extinguisher.** A fire extinguisher of 2-A:40-B:C rating or greater shall be mounted at the operator's station.

18.11.17 **Performance inspecting and testing.** Material hoists shall be performance tested under the direction of the design engineer or his/her designee. The test shall be conducted in

accordance with ANSI A10.5 requirements and paragraph 18.1.4, and shall include the car-arresting device.

18.12 AERIAL LIFTS

18.12.1 Requirement. Vehicle-mounted elevating and rotating aerial devices shall conform with the standards in the current edition of ANSI/SIA A92. They shall also conform to the standards contained in the current edition of ANSI/SIA A92.6, "Self-Propelled Elevating Work Platforms" and to the standards contained in the current edition of ANSI/SIA 92.3, "Manually Propelled Elevating Aerial Platforms." They also shall conform to the applicable requirements of this subsection and subsection 18.1 including provision for performance testing and inspection. Aerial lifts shall include the following types of vehicle-mounted aerial devices for elevating personnel: (a) extendible boom platforms, (b) aerial ladders, (c) articulating boom platforms, (d) vertical towers, or (e) any combination of (a), (b), (c), or (d).

18.12.2 Modification. Aerial lifts may be modified for uses other than those intended by the manufacturer, provided the modification has been certified in writing by the manufacturer or by other qualified equivalent entities, such as a testing laboratory, to be in conformity with the applicable provisions of ANSI A92.2, and the requirements of this subsection.

18.12.3 Ladder trucks and tower trucks. Aerial ladders shall be secured in the lower traveling position by a locking device on top of the truck cab and by a manually operated device at the base of the ladder before the truck is permitted to travel.

18.12.4 Routine testing. Prior to use each shift, the boom shall be elevated and the aerial lift checked to ensure that all controls and safety devices are functioning properly.

18.12.5 Operators. Operators shall be instructed and trained in the operation of the type of equipment to which they are assigned. Only persons specifically authorized to operate aerial lifts shall operate this type of equipment.

18.12.6 Body belts. Employees working from an aerial lift shall wear a body belt or safety belt and a lanyard attached to the basket, platform, or boom. He/she shall stand on the floor of the basket or platform and shall not sit or climb up on the guardrail or enclosure. Use of planks, ladders, or other devices for work platforms is prohibited.

18.12.7 Load limits. Load limits specified by the manufacturer shall be posted on the equipment and shall not be exceeded.

18.12.8 Stabilization. Aerial lifts shall be stabilized against movement or overturning through full and complete compliance with manufacturer or governing ANSI Standard requirements on slopes, restrictions, outriggers, extension, setting of brakes, and using wheel blocking or locking devices.

18.12.9 **Moving.** Aerial lift trucks, except for equipment specifically designed for that purpose, shall not be moved when the boom is elevated with persons in the basket or work platform.

18.12.10 **Controls.** Articulating boom and extensible boom platforms shall have both platform (upper) and lower controls. Upper controls shall be mounted on the basket or platform within easy reach of the operator. Lower controls shall be designed to override the upper controls. Controls shall be plainly marked as to their function. A person familiar with the machine lower controls shall be on the ground in the vicinity of the aerial lift at all times that employees are elevated. Lower controls shall not be operated without permission from the employee in the lift, except in an emergency.

18.12.11 **Welds.** All welds on aerial lift support members shall conform to the following standards and tests as applicable:

- a. Structural Welding Code, AWS D1.1-72.
- b. Specifications for Welding Industrial and Mill Cranes, AWS D14.1-70.
- c. Standards for Qualification of Welding Procedures and Welders for Piping and Tubing, AWS D10.9-69.
- d. Welds, the failure of which could result in dropping the boom or platform, shall be magnafluxed or dye penetration tested initially and at 2-year intervals thereafter.

18.12.12 **Hydraulic and pneumatic systems.** The provisions of ANSI A92.2, Section 4.7, "Bursting Safety Factors," shall apply to all critical hydraulic and pneumatic components. Critical components are those which a failure would result in a free fall or free rotation of the boom. All other components shall have a bursting safety factor of at least two.

18.12.13 **Insulated booms**

- a. *Testing and certification.* Any aerial device or component thereof, which is represented by the manufacturer or installer as being insulated, shall be tested and certified as set forth in ANSI A92.2, Section 5, "Predelivery Testing and Inspection of New Aerial Devices."
- b. *Operation.* The insulated aerial lift, when used to work on or near high-voltage lines or equipment, shall be tested, operated, and maintained in strict compliance with the manual or manuals provided by the manufacturer. The manual(s) shall contain:
 - 1. Descriptions, specifications, and capacities of the aerial device
 - 2. Instructions for installing or mounting the device
 - 3. Operating pressure of any hydraulic or pneumatic system which is part of the aerial device
 - 4. Specific instructions regarding field testing, operation, and maintenance

5. Replacement part information
6. Manufacturer's Certification Test

c. *Alteration.* Insulated portions of the lift, basket, and boom shall not be altered in any manner that might reduce its insulating value.

18.13 SPECIALIZED HOISTING SYSTEMS

18.13.1 **Manlifts.** Manlift design, installation, testing, and operations shall conform to requirements of ANSI A90.1, "Safety Standards for Manlifts."

18.13.2 **Draglines.** Draglines shall not be used as hoisting devices unless the units conform with applicable provisions of subsections 18.1 and 18.2.

18.13.3 **Powered industrial trucks.** Powered industrial trucks' design and operation shall conform with subsection 19.12. Powered industrial trucks shall not be used for hoisting personnel.

18.13.4 **A-frame trucks.** A-frame trucks' design and operation will conform with subsections 18.1 and 19.13. They shall not be used for hoisting personnel.

18.13.5 **Mobile hydraulic excavators and hoes, crawler, and wheel loaders and similar machines.**

a. *Requirement.* Mobile hydraulic excavators and hoes, crawler, wheel loaders, and similar machines shall not be used to hoist personnel. They may be used for hoisting materials when in conformance with the requirements of this paragraph and appropriate SAE-recommended practices. (See SAE J1097, J732, J818b, J31 for definitions of terms and basic capacity rating criteria.)

b. *Restrictions.* Only machines certified for hoisting by the manufacturer and equipped with manufacturer-installed closed lifting eyes or lugs will be used for hoisting. Maximum load in any machine position will not exceed rated capacity in least stable position.

c. *Testing.* Machine will be load tested at 110 percent of maximum load specified in paragraph "b." above. Test loads will be hoisted clear of ground at maximum load radius and moved through the maximum angle of articulation or arc radius in both directions from longitudinal centerline of the machine.

18.13.6 **Base-mounted drum hoists.**

a. *Requirements.* All base-mounted drum hoist supporting, suspension, or hoisting systems not covered elsewhere in section 18 are included here and shall conform to applicable provisions of this paragraph and subsection 18.1.

b. *Restrictions.* Base-mounted drum hoist systems involving personnel use or exposure (i.e., yo-yo operations, movable work platforms, raising or lowering drilling machines, personnel hoists) shall conform with applicable provisions of subsection 18.10. (See subsec. 19.2 for further information.)

c. *Hoists.* Base-mounted drum hoists shall conform with requirements of ANSI B30.7, "Base-Mounted Drum Hoists." Air-powered hoists shall conform with the requirements of ANSI/ASME HST-6M "Performance Standard for Air Wire Rope Hoists" or more stringent requirements of this section. Hoisting machines used in personnel related systems defined under "b" shall also meet the requirements of subsection 18.10.

d. *Design.* Hoisting systems covered by this subsection shall be designed by the hoist manufacturer or a professional engineer competent in the field. Additionally, the design entity will develop acceptable testing, inspecting, and operating criteria in accordance with requirements of paragraphs 18.1.1 and 18.1.4.

e. *Acceptance.* Hoist systems will not be installed until the design testing, inspecting, and operating criteria are completed.

f. *Inspection, test, and certification.* Installed systems shall be inspected by the design entity for conformance with design criteria and these requirements. Conforming systems will then be tested under the direction of the design entity or designee and in accordance with the accepted procedure. The design entity will then certify that the system conforms with the accepted design criteria and these requirements and can safely perform the intended service.

18.13.7 Facility maintenance hoisting systems. Hoisting systems used for inspection and maintenance of facilities such as penstocks, spillways, airshafts, and for external building maintenance such as window washing shall be designed, constructed, installed, and used in accordance with ANSI A10.22, "Safety Requirements for Rope-guided and Nonguided Workmen's Hoists" or ANSI A120.1, "Safety Requirements for Powered Platform for Exterior Building Maintenance." Such hoisting systems shall be certified for use intended by the manufacturer or a professional engineer competent in hoisting systems.

18.13.8 Helicopter operations

a. *Standards and regulatory authority.* Operators and aircraft shall be licensed and shall comply with the applicable regulations of the Federal Aviation Administration (FAA) and the more stringent requirements of this paragraph and current edition of ANSI B30.12, "Handling Loads Suspended from Rotorcraft." Reclamation operations will also comply with the Office of Aircraft Safety (OAS) safety regulations.

b. *Briefing.* Prior to each day's operation, a briefing shall be conducted for pilots and ground personnel to discuss in detail the plan of operation.

c. *Loads.* Suspended loads shall be secured with pressed sleeve, swedged eyes, or equivalent means in order to prevent hand splices from spinning open or cable from loosening. Taglines shall be of a length that will not permit their being drawn into the rotors.

d. *Cargo hooks.* Electrically operated cargo hooks shall have the electrical activating device so designed and installed to prevent accidental operation. These hooks shall also be equipped with an emergency mechanical control for releasing the load. The hooks shall be tested prior to each day's operation to ensure that they function properly.

e. *Personal protective equipment.* Employees receiving the load shall wear safety goggles and hardhats fitted with chinstraps. Loose fitting clothing that may become snagged on the hoist line shall not be worn.

f. *Downwash.* Material and loose gear within 100 feet of the lift or delivery site shall be removed or secured.

g. *Operator responsibility.* The helicopter pilot shall be responsible for size, weight, and manner in which loads are connected to the helicopter. The lift shall not be made if he/she considers it unsafe.

h. *Hooking and unhooking.* Employees shall not perform work under the hovering helicopter except as necessary to hook and unhook loads. A safe means of access shall be provided for employees to approach the hook to engage or disengage cargo slings.

i. *Static charge.* Unless a grounding device is used to dissipate the static charge, ground personnel shall wear rubber gloves.

j. *Weight limitations.* The weight of the load and rigging shall not exceed the aircraft manufacturer's rating, considering altitude and ambient temperatures existing at the time.

k. *Ground lines.* Hoist wires or other gear, except for pulling lines or conductors which "payout" from a container or roll off a reel, shall not be attached to any fixed ground structure or allowed to foul on any fixed structure. Pulling lines or conductor stringing systems will be designed with stress release hardware so located that it protects the aircraft against overload and line entanglement with rotors.

l. *Visibility.* When visibility is reduced by dust or other conditions, ground personnel shall exercise special caution to keep clear of the rotor blades. The employer shall reduce the possibility of dust to the extent it is practical.

m. *Approaching helicopters.* Only designated authorized personnel shall be permitted to approach within 50 feet of a helicopter with the rotor blades turning. When approaching or leaving a helicopter with the blades turning, persons shall keep within full view of the

pilot and assume a crouched position. Persons shall stay out of the area from the cockpit or cabin rearward unless authorized by the pilot to enter that area.

n. *Radio communication.* Provision shall be made for reliable radio communication between the pilot and a designated member of the ground crew during all loading, unloading, and rigging operations.

o. *Hand signals.* When hand signals are used, they shall be as illustrated in appendix F, "Helicopter Hand Signals." The signalperson on the ground shall be distinctly recognizable from other ground personnel.

p. *Inspection and maintenance.* Only FAA-certified personnel, experienced on type of aircraft being maintained, will be assigned to inspect or repair helicopters. Maintenance personnel shall be provided with lighting systems meeting minimum requirements set forth in ANSI/IES RP7, "Practice for Industrial Lighting." During inclement weather, repair work will be carried out in enclosures adequate to protect personnel against the elements. All repairs pertaining to safety of flight shall be flight-tested by an appropriate pilot prior to aircraft being returned to service.

18.14 **PILEDRIVERS**

18.14.1 **Hoisting equipment.** Cranes used to drive or extract piling shall conform to the requirements and standards set forth in applicable parts of this section.

18.14.2 **Floating piledrivers.** The width of hulls for floating piledrivers shall not be less than 45 percent of the height of the lead above water. The operating deck shall be protected to prevent suspended piling from swinging or drifting in over the deck.

18.14.3 **Hoist drums.** Piledriver hoist drums shall not be equipped with dogs that automatically disengage by relieving the load or by rotating the drum.

18.14.4 **Hose connections.** Hose connections to piledriver hammers, ejectors, or jet pipes shall be secured with at least a 0.25-inch chain having a minimum working load of 3,250 pounds or equivalent devices.

18.14.5 **Driving leads.** Hanging or swinging leads shall have fixed ladders for access. Fixed leads shall be provided with rings or attachment points for attaching safety belt lanyards. When fixed leads are provided with loft platforms, the platform shall be protected with standard guardrails. Employees shall use safety belts when working on the leads and shall not remain on the leads or ladders when piling is being driven.

18.14.6 **Landings and headblocks.** Fixed ladders or stairways shall be installed for access to landings and headblocks. Piledriver leads shall be provided with stopblocks to prevent the hammer from being raised into the headblock.

18.14.7 **Blocking device.** When employees are required to work under the hammer, a blocking device capable of supporting the hammer shall be placed in the leads.

18.14.8 **Guying.** Adequate guylines, outriggers, thrustboards, counterbalances, and/or rail clamps shall be used to stabilize piledrivers during operation.

18.14.9 **Moving piledrivers.** When the piledriver is being moved, the hammer shall be lowered to the bottom of the leads.

18.14.10 **Hoisting piling.** Piling shall be hoisted by means of a closed shackle or similar positive means of attachment of the loadline, and employees shall be kept in the clear. Taglines shall be used to control unguided piles and "flying hammers."

18.14.11 **Pulling pile.** Extractors shall be used to pull piling that cannot be pulled without exceeding the safe load rating of the pulling rig. When pulling piling, the crane boom shall not be elevated over 60 degrees from the horizontal.

18.14.12 **Overhead protection.** Overhead protection, equivalent to 2-inch planking, shall be positioned so as not to interfere with the operator's view.

18.14.13 **Headblock guards.** Guards shall be installed to prevent the line from jumping out of the headblock.

18.14.14 **Steam line controls.** Steam line controls shall consist of two shutoff valves. One of the valves shall be a quick-acting lever-activated type within reach of the hammer operator.

18.14.15 **Boilers and pressure vessels.** Boilers and pressure vessels used in piledriving operations shall conform to the requirements and standards set forth in Section 20, "Boilers, Compressors, and Gas Cylinders."

18.14.16 **Jacked piles.** When driving jacked piles, excavation for access pits shall conform to the requirements of Section 22, "Excavation Operations." Access ladders shall be provided and bulkhead curbs erected to prevent material from falling into the excavation.

18.14.17 **Cutting piling.** Cutting or trimming the tops of driven piling shall not be performed within a distance less than twice that of the longest pile from the driving rig.

18.15. CONVEYORS AND RELATED EQUIPMENT

18.15.1 **Requirement.** The design, installation, operation, and maintenance of conveyors and related equipment shall conform to the standards in the current edition of ANSI B20.1, "Safety Standards for Conveyors and Related Equipment," and the requirements of this subsection.

18.15.2 **Safe access.** Accessways shall be provided to enable employees to safely lubricate, repair, and maintain the conveyors. Stairways, ladders, catwalks, and/or work platforms shall

be provided to all areas requiring lubrication and maintenance. Such areas shall include elevated head pulleys, tail pulleys, and drive stations on belt conveyors. Unless rollers on a belt conveyor are self-lubricating or remotely lubricated, a walkway protected with a standard guardrail and toeboards shall be erected for access to all elevated sections of the conveyor system.

18.15.3 Startup signal. Conveyor systems shall be equipped with a time-delay audible warning system which will automatically sound an alarm before startup.

18.15.4 Anti-runaway device. On conveyors where reversing or runaway is a possibility, anti-runaway or "backup" stops shall be installed.

18.15.5 Start and stop switches. Start and stop switches, capable of starting and stopping drive motor(s) shall be provided at the operator's station. Stop switches shall be installed at each motor or engine location.

18.15.6 Emergency stopping. Whenever conveyors are installed within 8 feet of the ground and/or access is allowed along the conveyor or adjacent to unguarded moving parts of a conveyor presenting a hazard to employees, an emergency stop system shall be installed in these areas. The system shall consist of a line running along the entire length of the exposed section of conveyor or moving parts and attached to a power disconnect switch which, when pulled, will stop the conveyor. The system shall be designed so the conveyor cannot be restarted until the switch or disconnect has been manually reset.

18.15.7 Spillage. Conveyors shall be designed and installed with sideboards or other provision to eliminate spillage or dislodgement of materials.

18.15.8 Elevated crossings. Where conveyors pass adjacent to or over work areas, accessways, roadways, railways, etc., suitable and effective protection shall be installed. The overhead protection shall be capable of catching and retaining any material that may fall from the conveyor. Spilled material on retaining platforms or decking shall be removed daily to prevent overtopping of sideboards.

18.15.9 Crossovers and underpasses. Crossovers or underpasses, adequately protected, shall be provided for passage over or under conveyors.

18.15.10 Hazardous locations. Whenever conveyors are installed in tunnels, shafts, pits, and similar confined areas, ample room shall be provided to permit safe access. Where this is not possible, the conveyor shall be completely enclosed. Unless enclosed, emergency stop systems as set forth in paragraph 18.15.6 shall be installed. Such areas shall be provided with adequate lighting.

18.15.11 Stockpiled materials. Conveyor tunnels under stockpiled bulk materials such as sand and gravel shall be open at both ends.

18.15.12 **Hoppers, chutes, and bins.** Openings to hoppers, bins, chutes, or other hazard areas shall be guarded or protected to prevent employees from stepping or falling into them.

18.15.13 **Riding prohibited.** Riding material conveyors is prohibited and "**DANGER-NO RIDING**" signs shall be posted along the conveyor.

18.15.14 **Tag and lockout.** Conveyors, feed screens, and other moving parts shall be locked out or otherwise have the energy source isolated to render inoperable, and tagged with a "**DO NOT OPERATE**" tag during repair or hazardous maintenance work, except lubrication normally provided with conveyor operating.

Section 19

MOBILE AND STATIONARY MECHANIZED EQUIPMENT

19.1 GENERAL REQUIREMENTS

19.1.1 **Requirements.** Mobile mechanized equipment requirements contained and referenced in this section are applicable to all equipment propelled or drawn by mechanical power except rail equipment, passenger cars, station wagons, carryalls, trucks under 10,000 pounds, trailers under 3,000 pounds gross meeting DOT (Department of Transportation) design standards, snowmobiles, motorcycles, three wheelers, all-terrain machines, and similar equipment.

19.2 OPERATIONAL REQUIREMENTS

19.2.1 **Operators.** Mobile equipment shall be operated only by authorized employees who are qualified to operate the piece of equipment assigned. Operators shall receive the instruction and training required by section 3; meet physical requirements of section 2; meet licensing requirements of the DOT for on-highway operations; and not be at the jobsite over 12 hours in any 24-hour period. They shall comply with applicable operating instructions, limitations, and regulatory requirements contained in these standards, the employer's safety programs and plans, and those posted on the project site. Continued failure to comply with these operating and regulatory requirements shall be grounds for dismissal in accordance with subsection 3.6. Further, operators will not place or continue in service any equipment found to be in an unsafe condition.

19.2.2 **Unusual equipment configurations.** Refer to paragraphs 18.13.5 and 18.13.6.

a. *Definition.* Yo-yo operations of dozers or other earthmoving equipment; anchoring of mobile earthmoving or drilling equipment on steep slopes; hoisting with hydraulic excavating machines, multiple crane lifts or using a crane in conjunction with other equipment to lift loads, are examples of unusual equipment configurations.

b. *Requirements.* No equipment will be used in unusual configurations until the following information and procedural documents have been obtained and/or developed:

1. Equipment manufacturer or competent professional engineer's written approval.
2. Appropriate confirmation that hoisting systems used to raise, lower, suspend, or stabilize equipment on steep slopes meet applicable design, testing, and certification requirements of sections 17 and 18.
3. Development of a JHA as required by subsection 3.5.

4. Exceptions: (a) Hydraulic excavating machine hoisting operations conforming with applicable provisions of paragraph 18.13.5, and (b) operation of equipment on 30 percent or less grades when the operational assist system, dozer blades, loader buckets, dippers, winches, etc., are not required to stabilize the working machine in any operational configuration.

19.2.3 Parking, stopping, standing. No equipment shall be stopped, parked, or left standing on any road, ramp, accessway, or other location in such a manner to endanger personnel or property. Equipment will not be left unattended unless the motor has been shut off, brakes securely set, gears engaged, and all hydraulic or cable raised components lowered to a supporting surface or otherwise protected against accidental movement. Equipment parked on a hill or grade shall have the wheels chocked or turned towards the curb.

Transmix trucks, lubrication trucks, fuel trucks, and similar-type equipment utilizing primary engine-powered auxiliary equipment and/or exterior controls are not considered as being unattended when:

- a. The operator is outside the cab but within arms length of the unit or is in contact with auxiliary equipment or controls.
- b. The primary units' brakes and gearing arrangements designed for safe use of auxiliary attachments and/or exterior controls are in proper position.
- c. The primary unit is equipped with an automatic lockout device that prohibits operation of auxiliary attachments and/or exterior controls until brake and gear arrangements are in the proper position.

Diesel-powered earthmoving equipment being refueled or cooled down in a secured area or under visual observation of the operator or a mechanic, with brakes set and wheels chocked and hydraulic or cable raised components lowered to a supporting surface, are not considered as unattended.

19.2.4 Speeds. Equipment shall not be operated at speeds greater than are reasonable and safe considering weather conditions, traffic, road conditions, type and condition of equipment, etc. The operator must have the equipment under control at all times and be able to stop within the clear-sight distance.

19.2.5 Gears engaged. No vehicle shall be operated on a downgrade with gears in neutral or with clutch disengaged.

19.2.6 Towing. Employees shall not be permitted between a towed and towing vehicle except when hooking or unhooking.

19.2.7 Unattended at night. Equipment left unattended at night on or near roadways or in areas where work is in progress shall have lights, reflectors, or lighted or reflective barricades to identify the location of the equipment.

19.2.8 Unauthorized riding. Unauthorized personnel shall be prohibited from riding in or upon mobile equipment.

19.2.9 Securing loads. The load on every piece of mobile equipment shall be properly distributed, chocked, tied down, or otherwise secured. Tools and material transported in the same compartment as personnel shall be secured to prevent movement.

19.2.10 Seats and seatbelts. Except for standup-type operation, no operator or passenger shall ride upon or in equipment unless seated with installed seatbelt fastened.

19.2.11 Fire extinguishers and suppression systems. Mobile mechanized equipment described in paragraphs 19.7.1, 19.8.1, and 19.9.1 shall be equipped with fire extinguishers or a fire suppression system in accordance with paragraphs 19.7.9, 23.8.9, 24.3.2, or the type and number of units or systems deemed necessary by the COR or office head.

19.3 INSPECTION REQUIREMENTS

19.3.1 Initial. Prior to conducting required onsite brake performance tests and when directed by the COR or office head, mobile equipment shall be performance inspected by qualified personnel to ensure it is in safe condition, meets original design specifications, and these standards. The inspection will be conducted at the site in the presence of a Reclamation representative and recorded on the form illustrated in the applicable appendix or on other acceptable forms. All forms will be signed by the inspector. Nonconforming equipment shall be repaired and reinspected prior to being placed into service and/or brake tested. Equipment exempted from brake tests shall be inspected by the employer prior to onsite use. Nonconforming equipment shall be repaired and reinspected. A record of the inspection(s) shall be available for review.

19.3.2 Periodic. Equipment in service shall be inspected by a responsible employee at the beginning of each shift. The inspected unit will not be placed into service unless the following applicable equipment and accessories are in safe operating condition: service brake, emergency brake, parking brake, windows, tires, warning devices, steering mechanism, operating controls, wipers, defrosters, coupling devices, and other critical components. Daily inspection logs will remain with the vehicle.

19.4 MAINTENANCE REQUIREMENTS

19.4.1 Removal from service. Equipment shall be removed from service whenever an unsafe condition is detected. It shall not be placed back in service until repaired.

19.4.2 **Repair shutdown.** Equipment shall be shut down while repairs or adjustments are being made unless operation is essential to making the adjustments or repairs.

19.4.3 **Refueling.** Refueling shall be subject to requirements of paragraphs 11.12.4 and 19.2.3.

19.4.4 **Tire repair.** A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or dismounting tires installed on split rims or rims equipped with locking rings or similar devices. Welding on rims is prohibited unless the tire has been removed.

19.4.5 **Blocking.** Equipment or parts thereof suspended or held aloft by cables, hydraulic cylinders, slings, ropes, hoists, or jacks shall be blocked or cribbed or lowered to a supporting surface prior to permitting employees to work in, under, or between them.

19.4.6 **Brake repair.** A vacuum with a high efficiency particulate air (HEPA) filter shall be used to clean asbestos-lined brake assemblies. Compressed air shall not be used for this purpose.

19.5 **TESTING.** Operational tests, required by the manufacturer's maintenance and operational manuals accompanying the machine, shall be conducted at recommended intervals. Test results will be appropriately logged and available. In addition, onsite brake tests for specific equipment are set forth in this section and crane loading tests are set forth in section 18.

19.6 **ROADS**

19.6.1 **Requirement.** All roads, including haul roads, on the project site shall be designed in accordance with the requirements contained in this section. No mobile equipment shall be moved upon any road, accessway, or grades unless the roadway widths, grades, and curves are constructed to safely accommodate the movement of the vehicle or equipment at the speeds proposed by the employer.

19.6.2 **Design submittals.** The design of haul roads shall be submitted to and accepted by the COR or office head prior to road construction.

19.6.3 **Grades.** Maximum allowable grades shall be 12 percent. Loading and dumping ramps defined in paragraph 19.6.4 may be exempted from the requirement when all of the following conditions are complied with:

- a. The ramp grade does not exceed the lesser of:
 1. 25 percent.
 2. Manufacturer's recommended maximum grade for the equipment.

3. The maximum grade on which the machine loaded to the manufacturer's specified gross weight can be safely stopped and held.
- b. Acceptable machine gear range and ground speed for safely descending and stopping on the ramp have been determined by field testing or provided by the manufacturer.
- c. JHA is developed in accordance with section 3.5.

19.6.4 Loading and dumping ramps. Loading and dumping ramps are defined for the purpose of this subsection as follows:

- a. Sections of haul roads immediately adjacent to loading and dumping areas and the loading site per se.
- b. The ramp sections are less than 200 feet in length and the lower end either (1) stops on level ground no closer than 200 feet from foot traffic and/or congested equipment areas, or (2) is not directly aligned to terminate into these areas.

19.6.5 Curves. All curves shall have open sight lines and as great a radius as practical.

19.6.6 Embankment protection. When a difference in road or working level exists, berms, curbs, or barricades shall be constructed to prevent the vehicles or equipment from overrunning the edge or the end of the embankment. Berms or curbs constructed to one-half the diameter of the tires of the largest piece of equipment using the roadway will be considered to be adequate.

19.6.7 Drainage. Roadways shall be constructed with a slight crown and ditches provided to facilitate drainage.

19.6.8 Posting speed limits. All roads, including haul roads, shall be posted with curve signs and maximum speed limits. Vehicle speeds shall be limited on curves to those which permit the vehicle to be stopped within one-half the minimum sight distance. All curves shall be posted with acceptable speed limits.

19.6.9 Single-lane haul roads. Single-lane haul roads with two-way traffic shall be provided with adequate turnouts. When turnouts are not practical, a traffic control system shall be provided to prevent accidents. All employees must be advised of the traffic control system and operating restrictions.

19.6.10 Two-way haul roads. Whenever possible, a right-hand traffic pattern shall be used on two-way haul roads. Signs and traffic control devices shall be installed to safely control travel when a right-hand traffic pattern is not feasible.

19.6.11 Traffic control devices. The employer shall install traffic control devices including signal lights, signs, barricades, and/or flagpersons necessary to ensure the safe movement of traffic. Refer to subsections 9.6 and 9.7 relating to traffic control signals and flagpersons.

19.6.12 Road maintenance. All roadways, including haul roads, shall be routinely maintained in safe condition including the elimination or control of dust, ice, and similar hazards. Whenever dust conditions exist, adequate dust control equipment shall be available on the jobsite and shall be utilized to control the dust hazard.

19.7 ON-HIGHWAY TYPE EQUIPMENT

19.7.1 Requirements. On-highway trucks over 10,000 lb (GVW), truck-tractor/trailer combinations, transmix trucks, dump trucks and buses, man-haul vehicles, self-propelled and rubber-tired truck cranes and excavators, and all other similar on-highway type equipment shall meet applicable requirements of subsections 19.1, 19.2, 19.3, 19.4, 19.5, 19.6, this subsection, appendix V, and applicable DOT requirements contained in Federal Motor Carrier Safety Regulations 49 CFR 390-399 or applicable Society of Automotive Engineers (SAE) standards.

19.7.2 Lights. All equipment or combination of equipment shall have lighting systems meeting DOT requirements, but never less than: two headlights (one on each side), one red taillight on each side, one red stoplight on each side, directional signal lights on each side both front and rear.

19.7.3 Cabs, mirrors, warning devices. All equipment shall have cabs with shatter-resistant glazing in all windows, heaters, defrosters, windshield wipers, rearview mirrors, an audible warning device activated by a control on the steering column, and an automatic reverse signal alarm when operating in close proximity to personnel on foot, or in congested equipment areas.

19.7.4 Towing. Towing devices used on any combination of vehicles shall be structurally adequate for the load imposed and securely and properly mounted. A locking device shall be provided on fifth-wheel and tow bar systems which prevent accidental separation of the units. Safety chains will be provided for towed units up to 3,000 pounds gross weight and automatic breakaway stopping systems for towed units over 3,000 pounds gross weight.

19.7.5 Dump trucks and end-dump trailers. Dump trucks and end-dump trailers of all descriptions shall be equipped with the following safety devices:

- a. *Trip handles.* Trip handles or dump body operating levers which control hoisting or dumping shall be equipped with a latch or similar device which will prevent accidental starting or tripping of mechanism. The trip handle will be located so the operator remains clear of the load or dumping device.
- b. *Holding device.* A manually operated strut will be permanently attached to the truck body for use in preventing accidental lowering of the dump body or bed during inspection and/or maintenance operations.

c. *Cab protection.* Trucks loaded or unloaded by means of crane, power shovels, loaders, or similar equipment shall have a cab shield and/or a protective steel canopy adequate to protect the operator from falling or shifting material. When such protection is not installed, the operator shall leave the cab during loading or unloading operations.

d. *Tip-over safety device.* End-dump trailers designed for on-highway hauling and used in off-road hauling shall be equipped with a tip-over protection device. The device shall have a continuous monitoring display at the equipment operator station to provide the operator with a quick and easily read indicator showing safe, marginal, and unsafe degrees of lateral trailer tilt. Additional requirements are: an audible alarm that signals an unsafe degree of tilt (the audible alarm should have an on-off switch so that it can be switched off when not dumping); sufficient indicator lighting to be visible for night operation; and hookup flexibility for easy interchange between tractors and trailers.

19.7.6 **Fill openings.** Fill hatches on water tank trucks or trailers shall be guarded by either reducing the size of the opening to a maximum of 8- inches diameter, or by attaching a heavy metal grill to span the opening.

19.7.7 **Fenders and mudflaps.** All equipment whose maximum speed exceeds 15 miles per hour, shall be equipped with fenders or equivalent protective structures. Haul trucks shall be equipped with rear-wheel splash and stone-throw protection (mudflaps) conforming with SAE J682. All trucks traveling on unsurfaced roads shall meet mudflap requirements.

19.7.8 **Access requirements.** Any person entering or exiting the cab or requiring access to other work locations on the equipment shall be afforded sufficient steps and handholds and/or deck plates to allow the user to have at least three limbs in contact with the equipment at any time. Differing opinions as to access adequacy will be resolved in accordance with Federal Motor Carrier Safety Regulations. Differing opinions as to access adequacy will be resolved in accordance with Federal Motor Carrier Safety Regulations 399.207, "Truck and Truck-Tractor Access Requirements."

19.7.9 **Emergency equipment.** Trucks and combination of vehicles operated on public roads and all buses, man-haul vehicles, and vehicles carrying flammables, explosives, or hazardous materials shall be equipped with at least the emergency equipment described in subparagraphs "a." and "b." All mobile machines shall be equipped with fire extinguishers meeting requirements of subparagraph "c."

a. *Flags and reflectors.* One red flag not less than 12 inches square and three reflective markers is to be used.

b. *Wheel chocks.* Two wheel chocks for each vehicle or each unit of a combination of vehicles is to be used.

c. *Fire extinguishers.* One 2-A:40-B:C dry chemical extinguisher is to be installed. When transporting flammable or explosive cargo, there shall be at least two 2-A:40-B:C dry chemical, or other acceptable fire extinguishers.

19.7.10 Seatbelts. Seatbelts and anchorages meeting 49 CFR 393.93-Federal Motor Carrier Safety Regulations, "Seats, Seatbelt Assemblies and Seatbelt Assembly Anchorages," shall be installed in all equipment for the operator and all passengers. Seatbelt use is mandatory for operator and all passengers when the equipment is in motion.

19.7.11 Braking systems. All on-highway types of equipment shall have braking systems as described herein.

a. A bus, truck, truck-tractor, combination of vehicles, or similar type equipment referenced in paragraph 19.7.1 shall have the following braking systems that conform to these and appendix V requirements and 49 CFR 393.4-Federal Motor Carrier Safety Regulations "Required Brake Systems."

1. A service brake system.

2. A parking brake system.

3. An emergency brake system (equipment manufactured prior to July 1967 and trucks under 10,000 pounds gross vehicle weight (GVW) are exempted from the emergency brake system requirement if the system was unavailable from the manufacturer at date of manufacture, is presently unavailable from the manufacturer, and was not required by the standard in force at time of manufacture).

b. Self-propelled and truck cranes and excavators, mounted on rubber-tired chassis or frames, manufactured after July 1967, shall be equipped with a service braking system, secondary stopping (brake) system, parking brake system. All systems shall conform to SAE J1152 "Braking Performance---Rubber-tired Construction Machines," or DOT Federal Motor Carrier Safety Regulations 393.40 as applicable. (See applicable provisions of apps. U or V for detailed requirements.)

Equipment manufactured prior to July 1967 shall be equipped with an effective service braking system and parking brake system having, as a minimum, the features, components, and capabilities set forth in appendix U or V as applicable. The machine shall also be equipped with an effective emergency braking system meeting the requirements of appendix U unless the system was not required by the standards or regulations in force at the date of manufacture and is not available from the manufacturer.

19.7.12 Brake performance test. The contractor shall, after satisfactorily completing initial inspection requirements of subsection 19.3 and appendix U or V, equipment shall be subjected to an onsite brake performance test prior to initial onsite use, annually thereafter, and after repair or maintenance of braking systems. (Equipment owned/leased and operated by suppliers

and engaged in limited operation on the project are exempted from brake performance test and inspection requirements).

Onsite brake performance tests will be conducted in the presence of a Reclamation representative on each piece of equipment in accordance with the manufactures prescribed method for brake performance testing if:

- a. The procedure is in writing.
- b. Provides a method to verify the operation of the service, emergency and parking brake systems
- c. Is in the manufacturer's opinion adequate to verify that the braking systems would meet the applicable SAE standard requirements.

In lieu of an acceptable manufacturer-approved brake performance test procedure, onsite brake performance tests will be conducted in the presence of a Reclamation representative on each piece of equipment in accordance with method and procedures described in the appropriate appendix. Test results will be recorded on the appropriate form, the form signed by the inspector and maintained in the equipment file. Equipment failing the test shall not be placed into service until repaired and retested. See subsection 19.3 and appendixes U and V for initial and periodic inspection requirements.

19.8 CRAWLER EQUIPMENT

19.8.1 Requirements. Crawler equipment and operations shall meet requirements of this subsection and applicable requirements of subsections 19.1, 19.2, 19.3, 19.4, 19.5, and 19.6.

19.8.2 Rollover protective structures (ROPS). ROPSs shall be installed on all crawler tractors and crawler loaders except side boom crawler tractors when equipped with seatbelts and the boom and counterweights are installed. The ROPSs shall conform to requirements of the latest edition of SAE J1040, "Performance Criteria for Rollover Protective Structures (ROPS) for Construction, Earthmoving, Forestry, and Mining Machines."

19.8.3 Falling objects protective structures (FOPS). Crawler tractors and loaders used in operations that expose the operator to falling objects shall be equipped with protective structures meeting criteria contained in SAE J231, "Minimum Performance Criteria for Falling Object Protective Structure (FOPS)." Crawler equipment protective structures providing equal protection shall meet these requirements.

19.8.4 Operator enclosure. Crawler tractors, loaders, or forestry machines used in tree-clearing-type operations or other operations where objects may intrude into the operator's area shall be equipped with enclosures conforming to SAE J1084, "Operator Protective Structure Performance Criteria for Certain Forestry Equipment."

19.8.5 Certification of protective structures (ROPS)(FOPS). Certification that protective structures, ROPS and FOPS, meet required design criteria must be available for review prior to equipment use. Acceptable methods of certification are:

- a. Manufacturer or professional engineer's written confirmation that the structures meet required design criteria
- b. Permanent labels conforming to SAE J1164, "Labeling of ROPS and FOPS," permanently attached to the structure

19.8.6 Modification or repair of protective structures - ROPS and FOPS. Modification or repair of protective structures of ROPS and FOPS without manufacturer or professional engineer's written approval shall void certifications. The mobile equipment on which the decertified protective structure(s) is installed shall be removed from service until the modified or repaired protective structure is recertified or replaced. Damaged protective structures shall be removed from service until recertified.

19.8.7 Braking systems. Crawler equipment shall have service and parking brake systems adequate to stop and hold the machine on all working surfaces. Crawler tractors and loaders manufactured after June 1982 will conform to requirements of SAE J1026, "Braking Performance---In-Service Crawler Tractors and Crawler Loaders."

19.8.8 Accessories. All crawler equipment shall be equipped with the following accessories:

- a. *Lights.* Machines operated at night or when vision is obscured shall be equipped with two symmetrically mounted lights or floodlamps that illuminate the forward working area and one light or floodlamp of equal intensity for illuminating the rear working area. Further, one bucket lamp shall be provided on all shovels and excavators. Slow-moving vehicles such as dozers, operating on public or haul roads, in barrow or fill areas shall also be equipped with a rotating amber light or equivalent that is visible in all directions.
- b. *Warning devices.* An automatic backup alarm will be installed on all bidirectional equipment, which has obstructed vision to the rear. The alarm will be functional when the equipment is working in close proximity to foot traffic or congested equipment areas.

19.8.9 Access systems. Personnel entering, leaving, or working in/on operator cabs/stations or inspection or service platforms shall be provided steps, stairways, ladders, walkways, platforms, handholds, guardrails, and entrance openings in accordance with SAE J185, "Access Systems for Off-Road Machines." Such systems will provide for the person to achieve three points of support at all times.

19.8.10 Seatbelts. Seatbelts shall be installed on all equipment protected by rollover protective structures or as required elsewhere in these standards. Seatbelts for all construction machines defined in SAE J1116, "Categories of Off-Road Self-Propelled Work Machines,"

shall meet the design and installation standards set forth in SAE J386, "Seat Belts for Construction Machines." Where seatbelts are installed, their use is mandatory.

19.8.11 Equipment cabs. Equipment cabs shall meet applicable requirements of paragraph 19.9.9.

19.8.12 Barricades. The swing radius area of rotating superstructures of track hoes or similar equipment shall be barricaded in a manner that physically prevents persons or equipment from being struck by the superstructure.

19.9 OFF-HIGHWAY WHEEL CONSTRUCTION MACHINES

19.9.1 Requirement. Off-highway wheeled construction machines, including loaders and tractors, scrapers, dumpers, graders, rollers and compactors of mass greater than 5,952 pounds, water wagons, and similar-type equipment, shall conform with this subsection and applicable provision of subsections 19.1, 19.2, 19.3, 19.4, 19.5, and 19.6. Mobile, self-propelled cranes shall conform to applicable provisions of subsection 19.7.

19.9.2 Rollover protective structures (ROPS). All equipment described in paragraph 19.9.1 shall be equipped with rollover protective structures meeting the requirements of paragraph 19.8.2.

19.9.3 Falling objects protective structures (FOPS). All equipment described in paragraph 19.9.1 shall be equipped with falling objects protective structures meeting the requirements of paragraph 19.8.3 when used in machine loading operations or other operations that expose the operator to falling objects.

19.9.4 Operator enclosure. All equipment used in operations described in paragraph 19.8.4 shall be equipped with enclosures meeting the requirements of paragraph 19.8.4.

19.9.5 Certification of protective structures. Protective structures (ROPS and FOPS) shall be certified by the methods described in paragraph 19.8.5.

19.9.6 Modification or repair of protective structures (ROPS) (FOPS). Modification and repair of protective structures shall conform with requirements and restrictions set forth in paragraph 19.8.6.

19.9.7 Access systems. Machine access systems shall conform to criteria contained and referenced in paragraph 19.8.9.

19.9.8 Seatbelts. Seatbelts shall be installed on equipment described in paragraph 19.9.1 and installations shall conform with requirements of paragraph 19.8.10 or other standards providing equal protection. Where seatbelts are installed, their use is mandatory.

19.9.9 Accessories

- a. *Lights.* All equipment described in paragraph 19.9.1 shall have lights and markings conforming to SAE J1029, "Lighting and Marking of Construction and Industrial Machinery," when used on the project site. Equipment used on public roads or in public areas shall be equipped for highway operation. All lighting systems installed on equipment shall be maintained in operating condition. Slow-moving vehicles, such as motor graders, end loaders, agricultural and industrial equipment operating on public or haul roads, in borrow or fill areas, shall also be equipped with a slow-moving machine sign and a rotating amber light or equivalent that is visible in all directions.
- b. *Cabs, mirrors, warning device.* Machine cabs shall be equipped with shatter-resistant glazing in all windows, heaters, defrosters, windshield wipers, and door restraints. Bidirectional machines shall be provided with rearview mirrors. Machines provided with windshields but no cab shall be equipped with windshield wipers.
- c. *Audible alarms.* All mobile equipment shall be equipped with a horn distinguishable from the surrounding noise level and an automatic backup alarm. The backup alarm will be functional whenever the equipment is working in close proximity to foot traffic or congested equipment areas.
- d. *Tires.* Tires shall be replaced when the tread wear reaches the first ply of the cord, unless an alternative replacement criteria is recommended by the tire manufacturer.

19.9.10 **Fenders.** Pneumatic-tired earthmoving haulage equipment, including dumpers, scrapers, tractors, whose maximum speed exceeds 15 miles per hour, shall be equipped with fenders meeting the criteria set forth in SAE J321a, "Fenders for Pneumatic-tired Earthmoving Haulage Equipment," or SAE J321b, "Tire Guards for Protection of Operators of Earthmoving Haulage Machines," or devices providing equivalent protection.

19.9.11 **Emergency steering.** Wheeled machines such as scrapers, haul trucks, end-dumps, and rock trucks shall be equipped with emergency steering meeting requirements of SAE J53 if:

- a. The equipment was manufactured in or after 1980.
- b. Maximum rated speed is in excess of 12.4 mi/h.
- c. The machine employs a power source(s) in addition to the operator control effort to effect machine steering.

19.9.12 **Scissor points.** Scissor points on articulating machines or loaders constituting a hazard to personnel shall be guarded.

19.9.13 **Safety devices.** Dumpers shall have applicable safety devices required by paragraphs 19.7.5 "a." and "b."

19.9.14 **Fill openings.** Fill hatches on water tank trucks or trailers shall be guarded by either reducing the size of the opening to a maximum of 8 inches diameter, or by attaching a heavy metal grill to span the opening.

19.9.15 **Braking systems.** All equipment described in paragraph 19.9.1 shall, regardless of age, be equipped with an operable, service braking system, emergency stopping (brake) system, and parking brake system. The braking systems shall conform with the criteria contained in SAE J1152, "Rubber-tired Construction Machines," and appendix W. Units manufactured prior to 1980 may conform to the SAE Standard under which they were manufactured, if the standard requires (1) a service brake system, an emergency brake system, and a parking brake system, and (2) that failure of any one system or component will not reduce the effectiveness of the machine's stopping capability below the emergency stopping performance criteria shown in appendix W. In no circumstances shall dropping the scraper bowl, loader bucket, grader/tractor blade, or equipment loads be considered as an emergency braking system.

19.9.16 **Brake performance test.** The employer shall, after satisfactorily completing initial inspection requirements of subsection 19.3 and appendix W, conduct onsite brake performance tests on all equipment described in paragraph 19.9.1 prior to initial use, annually thereafter, and when directed to do so by the COR or office head.

a. Onsite brake performance tests will be conducted in the presence of a Reclamation representative on each piece of equipment in accordance with the manufacturer's prescribed method for brake performance testing if:

1. The procedure is in writing.
2. Provides a method to verify the operation of the service, emergency and parking brake systems.
3. Is in the manufacturer's opinion adequate to verify that the braking systems would meet the applicable SAE standard requirements.

b. In lieu of an acceptable manufacturer's approved brake performance test procedure, onsite brake performance tests shall be conducted in accordance with the following procedures:

1. In the presence of a Reclamation representative, each required braking system (service, emergency, parking) shall be individually tested in accordance with criteria set forth on the applicable Reclamation form entitled, "Brake Performance Test Record," shown in appendix W.

2. Each test result will be recorded on the form and the form signed by the contractor and Reclamation representative.

3. Equipment failing the test shall not be placed into service until corrective measures have been taken and retest confirms compliance with requirements.

19.10 AGRICULTURAL AND INDUSTRIAL EQUIPMENT

19.10.1 Requirement. Agricultural wheeled tractors and industrial equipment including tractors, loaders, backhoe loaders, trenchers, and similar type equipment will conform with this subsection and applicable provisions of subsections 19.1, 19.2, 19.3, 19.4, 19.5, and 19.6.

19.10.2 Rollover protective structures (ROPS). Agricultural wheeled tractors shall be equipped with rollover protective structures meeting the requirements of SAE J1194, "Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors." Industrial-type equipment, described in 19.10.1, shall have rollover protective structures (ROPS) meeting the requirements of SAE J1042, "Operator Protection for Industrial Equipment."

19.10.3 Falling object protective structures (FOPS). Equipment described in paragraph 19.10.1 shall be equipped with protective structures (FOPS) when operating conditions subject the operator to falling material. Agricultural wheeled tractor structures shall conform to requirements of SAE J167, "Overhead Protection for Agricultural Tractors." Industrial-type equipment structures shall conform to requirements of J1042, "Operator Protection for Industrial Equipment."

19.10.4 Operator enclosures. All equipment used in operations described in paragraph 19.8.4 shall be equipped with enclosures meeting the requirements of paragraph 19.8.4.

19.10.5 Certification of protective structures (ROPS) (FOPS) shall be certified by the methods described in paragraph 19.8.5.

19.10.6 Modification or repair of protective structures (ROPS and FOPS). Modification and repair of protective structures shall conform to requirements and restrictions set forth and referenced in paragraph 19.8.6.

19.10.7 Access systems. Machine access systems shall conform to criteria contained and referenced in paragraph 19.8.9.

19.10.8 Seatbelts. Seatbelts shall be installed on agricultural wheeled tractors and installations shall conform with SAE J1194, "Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors." Seatbelts shall be installed on all industrial-type equipment described in paragraph 19.10.1. Installations shall conform with SAE J1042, "Operator Protection for Industrial Equipment." Where seatbelts are installed, their use is mandatory.

19.10.9 Accessories

- a. *Lights.* Agricultural wheeled tractor lighting and markings shall conform with SAE J137, "Lighting and Marking of Agricultural Equipment on Highways," and applicable requirements of paragraph 19.9.9. Industrial-type equipment described in paragraph 19.10.1 shall conform with applicable requirements of paragraph 19.9.9.
- b. *Cabs, mirrors.* Equipment described in paragraph 19.10.1 shall conform with applicable requirements of paragraph 19.9.9.
- c. *Audible alarms.* All equipment described in paragraph 19.10.1 shall be equipped with a horn distinguishable from surrounding noise levels. The horn-activating device shall be accessible to the operator when seated at the machine controls.

19.10.10 **Braking systems.** All equipment described in paragraph 19.10.1 shall have service and parking braking systems that can stop and hold the equipment on any working surface.

19.11 MAN-HAUL VEHICLES AND BUSES

19.11.1 **Requirement.** In addition to applicable requirements set forth in subsections 19.1, 19.2, 19.3, 19.4, 19.5, and 19.6, man-haul vehicles and buses shall conform to this subsection and applicable provisions of subsection 19.7.

19.11.2 **Type of equipment.** Only fully enclosed vehicles with seats and seatbelts for operators and passengers shall be used to transport employees.

19.11.3 **Operator qualifications.** Operators of man-haul vehicles and buses shall be 21 years of age or older and have in their possession valid State operator's permits or licenses for the type of vehicle being operated. The operator must have passed a physical examination within the past year showing him/her physically qualified to operate the vehicle safely.

19.11.4 **Starting.** Vehicles transporting personnel shall not be moved until the operator has checked that all persons are seated, seatbelts are fastened, and the required doors are closed.

19.11.5 **Tools and materials.** Tools and materials shall be placed in containers or secured when transported in vehicles carrying personnel.

19.12 INDUSTRIAL TRUCKS

19.12.1 **Requirement.** All industrial trucks shall meet the requirements for design, construction, stability, inspection, testing, maintenance, and operation as set forth in ANSI/ASME B56.1, "Low Lift and High Lift Trucks;" ANSI/ASME B56.6, "Rough Terrain Forklift Trucks;" 29 CFR 1910.178; and subsection 18.13, as applicable. High lift rider trucks shall be equipped with overhead guards as described in ANSI B56.1.

19.12.2 **Lift trucks and stackers.** Lift trucks, stackers, etc., shall have capacity plates posted on the equipment in the operator's view. When removable counterweights are used, the corresponding rated capacities shall not be exceeded by the operator. No modifications or additions affecting the capacity or safe operation of the equipment shall be made without the manufacturer's written approval and the capacity plates correspondingly revised.

19.12.3 **Multiple lifting.** When a load is lifted by two or more trucks working in unison, the proportion of the total load being lifted by any one truck shall not exceed its capacity.

19.12.4 **Steering knobs.** Steering or spinner knobs shall not be attached to the steering wheel unless the steering mechanism is of a type which prevents road reactions from causing the steering wheel to spin. The knob shall be mounted within the periphery of the wheel.

19.13 A-FRAME TRUCKS

19.13.1 **Design.** A-frame trucks and similar job-fabricated mobile hoisting equipment shall conform to this subsection and applicable provisions of subsections 18.1 and 18.13, and be designed by a registered professional engineer experienced in the design of such equipment. A written certification attesting that the equipment meets requirements of paragraph 19.13.2 shall be provided.

19.13.2 **Safety factor.** A minimum safety factor of 5 shall be incorporated in the design of chains, standing part or guy cables, boom supports, and other load-carrying boom (A-frame) parts. Live or running cable reevings including boom hoist cables, shackles, hooks, and accessories shall have a minimum safety factor of 3.5.

19.13.3 **Performance inspection and testing and capacity charts.** Prior to use, annually thereafter, and after modification or repair, all such equipment shall be load tested at 110 percent of rated capacity in accordance with applicable provisions of paragraph 18.1.4. Capacity charts must be installed on the equipment in full view of the operator.

19.14 OTHER MECHANIZED CONSTRUCTION EQUIPMENT STANDARDS

19.14.1 **Requirement.** In addition to specific requirements set forth elsewhere in this manual, the requirements set forth in this subsection shall apply to all stationary mechanized equipment and drives.

19.14.2 **Guarding.** Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment shall be guarded or isolated in order that they do not endanger persons or property. Guarding shall comply with the standards set forth in the current edition of ANSI B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

19.14.3 **Working platforms.** Equipment shall be provided with adequately designed working platforms, guardrails, and accessories providing a safe footing for operating and maintenance personnel.

19.14.4 **Fuel tanks.** Fuel tanks shall be located in a manner which will not permit spills or overflows to contact the engine, exhaust, or electrical parts.

19.14.5 **Removal of guards.** Guards and safety devices shall not be removed or rendered ineffective except for necessary repairs or maintenance and then only after the power has been shut off. The guards and safety devices shall be replaced and made operable prior to restarting the equipment.

19.14.6 **Hot surfaces.** Hot surfaces of equipment, including exhaust pipes, steam pipes, etc., shall be either isolated, guarded, or insulated to prevent contact by persons.

19.14.7 **Exhaust fumes.** Exhaust or discharges from equipment shall be confined or controlled so they do not endanger employees or obstruct the operator's view.

19.14.8 **Rock crushers.** Rock crushers and similar equipment shall be screened to prevent flying chips or rocks from injuring persons in the vicinity.

19.14.9 **Vibrating and rocker screens.** Vibrating or rocker screens shall be equipped with sides and baffles to prevent rock from falling from the screen. Where materials are being processed dry, exhaust systems shall be installed to remove the dust.

19.14.10 **Tagging and locking.** Power-driven equipment shall be installed with provision for locking out the controls or switches while under repair. An effective lockout and tagout program in accordance with section 15 shall be established prescribing specific responsibilities and procedures to be followed by the person(s) performing the repair work. This type of equipment shall be both locked out and tagged out during repair. For electrically driven equipment, refer to subsection 12.10.

19.14.11 **Certification.** The design for all major facilities and equipment built or provided by Reclamation or the contractor for their use, such as conveyors, materials handling systems, hoists, personnel hoists, manlifts, concrete forming support systems for major structures, and similar equipment, shall be certified as structurally suitable for the use intended. This certification shall be made in writing by the manufacturer or a registered professional engineer competent in these fields and shall be submitted prior to erection or use of such facilities and equipment on the jobsite. (Refer to sec. 2, 18, 22, 25, and specifications for additional requirements.)

Section 20

RESERVED

Section 21

RESERVED

Section 22

EXCAVATION OPERATIONS

22.1 GENERAL REQUIREMENTS

22.1.1 General. Requirements contained in this subsection apply to all types of excavation operations except tunnels and shafts covered by section 23. When general requirements differ with specific requirements in subsections 22.2, 22.3, and 22.4, requirements of the specific subsections will prevail.

22.1.2 Preliminary inspection. Prior to excavation, the site shall be thoroughly inspected to determine conditions requiring special safety measures. The location of underground installations such as sewer, telephone, gas, water, electric lines, etc., shall be determined and plainly staked. Necessary arrangements shall be made with the utility company or owner for the protection, removal, or relocation of the underground installations. In such circumstances, excavation shall be done in a manner that does not endanger the underground installation or the employees engaged in the work. Utilities left in place shall be protected by barricading, shoring, suspension, or other measures as necessary.

22.1.3 Protection of the public. Necessary barricades, walkways, lighting, public awareness program, and posting shall be provided for the protection of the public prior to the start of excavation operations. Excavation operations on or near State, county, or city streets or accessways or other locations where there are extensive interface with the public and/or motorized equipment, shall not start until all of the following actions have been taken:

- a. Written permission to proceed together with protective measures required has been obtained from the authority having jurisdiction.
- b. A JHA (see subsec. 3.5) has been developed.
- c. The completed JHA has been submitted to and accepted by the designate authority.
- d. The JHA has been discussed with affected employees and the applicable protective measures are in place and functioning.
- e. Where required, a public awareness program has been implemented.

22.1.4 Access and egress. Safe access shall be provided for employees including installation of walkways, ramps, stairs, and ladders.

a. Structural ramps.

b. Stairs, ladders, or ramps shall be provided so as to require no more than 25 feet (7.62 m) of lateral travel where employees are required to enter trench excavations over 4 feet (1.22 m) in depth. Ramps, stairs, or personnel hoists shall be provided for access when access to excavations exceeds 20 feet (6.10 m) vertically.

22.1.5 Lighting. Lighting, either natural or artificial illumination, shall be provided at the excavation site, borrow pits, and waste areas in accordance with illumination requirements of paragraph 7.14.3.

22.1.6 Personal protective equipment. Personal protective equipment shall be provided and used in accordance with the specific requirements set forth in section 8. Employees exposed to occupational health hazards shall be protected as set forth in section 7.

22.1.7 Removal of surface encumbrances. Trees, brush, boulders, and other surface encumbrances presenting a hazard to employees shall be removed prior to excavation.

22.1.8 Inspections.

a. Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall be made following every rainstorm or other hazard-increasing occurrence.

b. Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

22.1.9 Structure foundations and footings. Shoring, bracing, or underpinning designed by a professional engineer shall be installed if the excavation endangers the stability of adjacent buildings or structures. Such supporting systems shall be inspected at least daily by qualified persons to ensure that the protection is adequate and effectively maintained.

22.1.10 Vertical cuts and slopes. Employees working below or on slopes or cuts when exposed to falling, rolling, or sliding rocks, earth, or other materials shall be protected in the following manner:

a. *Scaling.* By effective scaling performed prior to exposure and at intervals necessary to eliminate the danger.

b. *Rock bolting.* Rock bolting, wire mesh, or equivalent support shall be installed when material continues to ravel and fall following thorough scaling.

c. *Barricades.* Protective timber or wire mesh barricades shall be installed at the top of the cut and at necessary intervals down the slope.

d. *Benching.* Wherever practical, benching sufficient to retain falling material may be used in lieu of barricades.

e. *Placement of personnel.* Personnel shall not work above one another where danger of falling rock or earth exists. Personnel performing work on vertical cuts or slopes where balance depends on a supporting system shall be protected from falling in accordance with requirements of section 8.

22.1.11 **Support materials.** Materials used for sheeting, piling, cribbing, bracing, shoring, and underpinning shall be in good serviceable condition and timbers shall be sound and free of large or loose knots.

22.1.12 **Backfilled excavation.** Special precaution shall be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or fill area. Using compacted backfill as backforms on slopes steeper than 34 degrees measured from the horizontal (1-1/2 horizontal to 1 vertical) slopes is prohibited.

22.1.13 **Ground water.** Ground water shall be controlled. Freezing, pumping, drainage, and other major control measures shall be planned and directed by a competent professional engineer. Full consideration shall be given to the existing moisture balances in surrounding soils and the effects on foundations and structures if it is disturbed. When continuous operation of ground-water control equipment is necessary, an emergency power source shall be provided.

22.1.14 **Surface water.** Water shall not be permitted to accumulate in excavations. Diversion ditches, dikes, dewatering sumps, or other effective means shall be used to control surface water.

22.1.15 **Crossovers.** Walkways or bridges protected by standard guardrails shall be provided where employees are required or permitted to cross over excavations.

22.1.16 **Undercuts.** When necessary to undercut a slope or vertical cut, the residual material shall be adequately supported. The undercutting method and support system shall be approved prior to starting undercutting operations.

22.1.17 **Excavated materials.** Excavated materials shall be placed and retained at least 2 feet (0.61 m) from the edge of the excavation or at a greater distance when required to prevent hazardous loading on the face of the excavation.

22.1.18 **Protective devices.** Guardrails, fences, or barricades and warning lights or other illumination systems shall be maintained from sunset to sunrise on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Wells, subsurface exploration holes, pits, shafts, and all similar hazardous excavations shall be effectively barricaded or covered and posted. All temporary excavations of this type shall be backfilled as soon as possible.

22.1.19 **Stoplogs.** When mobile equipment is permitted adjacent to excavations with steep slopes or cuts, substantial stoplogs or barricades shall be installed.

22.1.20 **Equipment operation.** Equipment operating in loading or waste areas shall be equipped with an automatic backup alarm. Additionally, when employees are on foot or otherwise endangered by equipment in dumping or waste areas, a competent signalperson shall be employed to direct traffic. The signalperson shall have no other assignment that interferes with signaling duties.

22.1.21 **Hazardous atmospheres.** In locations where oxygen deficiency or gaseous conditions are known or suspected, air in the excavation shall be tested prior to the start of each shift or more often if directed by the COR or office head. (Refer to sec. 7.) A log of all test results shall be maintained at the site. If the oxygen level is less than 19.5 percent, the concentration of flammable gas exceeds 20 percent of the lower flammable limit, or toxic materials exist at levels exceeding the TLV, steps such as increased ventilation will be taken to control the hazards.

22.2 REQUIREMENTS FOR EXCAVATION PROTECTIVE SYSTEMS

22.2.1 **Requirement.** All excavations 5 feet (1.52 m) or more in depth shall be sloped or benched in accordance with one of the systems outlined in "a." through "d." below:

a. For excavations less than 20 feet (6.10 m) in height, the maximum slope shall be 34 degrees measured from the horizontal (1-1/2 horizontal to 1 vertical), unless one of the options listed below in "b.", "c.", or "d.", is used.

b. The maximum allowable slopes, and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendix M.

c. The design shall be selected from and be in accordance with written tabulated data, such as charts and tables. At least one copy of the tabulated data shall be maintained at the jobsite during excavation. The tabulated data shall include:

1. Identification of the parameters that affect the selection of a sloping or benching system drawn from the data.

2. Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe.
 3. Explanatory information as may be necessary to aid the user in correctly selecting a protective system from the data.
 4. The identity of the registered professional engineer who approved the data.
- d. The sloping or benching system shall be designed by a registered engineer. At least one copy of the design shall be maintained at the jobsite during excavation. Designs shall be in writing and include:
1. The magnitudes and configurations of the slopes that were determined to be safe for the particular excavation.
 2. The identity of the registered engineer who approved the design.

22.2.2 Support systems. Sheet piling, sheet piling, bracing, shoring, trench boxes, and other methods of excavation/trench protection shall be designed by a professional engineer competent in the field, and installed by qualified persons. Designs shall be in written form and shall include the following:

- a. A plan indicating the sizes, types, and configurations of the materials to be used in the protective system.
- b. The identity of the registered professional engineer approving the design.
- c. At least one copy of the design shall be maintained at the jobsite.

22.2.3 Shoring design requirements. Design criteria support systems or shoring shall meet or exceed the minimum requirements set forth in this subsection and in appendix M. Braces and diagonal shores in a timber shoring system shall not be subjected to compressive stresses in excess of the values given in the following formula:

$$S = 1300 - \frac{20L}{D}$$

$$\text{maximum ratio } \frac{L}{D} = 50$$

where:

L = length, unsupported, in inches

D = least dimension of timber, in inches

S = allowable stress of cross section, in pounds per square inch

22.2.4 Shoring, sloping, benching, trench box illustrations. Figures in appendix M tentatively illustrate the basic shoring, sloping, benching, trench box, and shield requirements contained in this subsection.

22.2.5 Trench boxes and/or shields. Use of portable trench boxes, sliding trench boxes, and/or shields in lieu of required sloping, benching, or supporting methods may be authorized by the designated authority when:

- a. The boxes and/or shields are designed by a competent professional engineer and provide equivalent protection to shoring and sheeting for the same condition, and conform to requirements of appendix M.
- b. The boxes and/or shields are constructed and maintained to design standards.
- c. A JHA (see subsec. 3.5) covering operation and maintenance of the boxes and/or shields has been developed and training and instruction to affected employees has been provided on the effective use of the protective system.
- d. Backhoes, excavators, and/or cranes used to move trench boxes and/or shields meet the applicable requirements of subsection 18.2 and paragraph 18.13.5.

22.2.6 Placement of shoring, trench box, or shields. Shoring, trench box, or shield shall be carried along with the excavation and shall not be omitted where the depth of trench and soil conditions require shoring or bracing. Where a backhoe or ditching machine is used, the shoring trench box or shield shall be placed as close as possible to the lower end of the boom. Excavations may extend no more than 2 feet (0.61 m) below the bottom of shoring, trench boxes, or trench shields if the protective systems are designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

22.2.7 Removal of support. Backfilling and removal of trench support systems shall progress together from the bottom of the trench. Jacks or braces shall be released slowly. In unstable soil, ropes or other safe means shall be used to remove the braces from the surface after the employees have left the trench. (See paragraph 22.1.5 b.)

22.2.8 Cross braces and jacks. Cross braces and trench jacks shall be placed in true horizontal position and secured to prevent sliding, falling, or kickouts.

22.3 STRUCTURE FOOTINGS

22.3.1 **Requirement.** Small diameter footings, including bell-bottom footings over 4 feet (1.22 m) deep which employees are required to enter, shall be provided with a steel casing or support system designed with sufficient strength to support the earth walls and prevent cave-ins. The casing or support system shall be provided the full depth except for the bell portion of bell footings.

22.3.2 **Access.** Fixed or portable ladders shall be provided for access. A lifeline securely attached to a shoulder harness shall be worn by every employee entering the footing. The lifeline shall be manned from above and shall be separate from any line used to raise or lower materials.

22.4 COFFERDAMS

22.4.1 **Controlled flooding.** Where overtopping of a cofferdam is possible, the design shall provide for controlled flooding of the work area. Further, an evacuation plan, including installation of warning signals and emergency exits, shall be devised for the safe evacuation of personnel and equipment from the work area.

22.4.2 **Walkways and guardrails.** Where employees are permitted on cofferdams, safe walkways protected by guardrails shall be installed.

22.4.3 **Exit.** A rapid means of exit shall be provided for personnel and equipment working on cofferdams.

Section 23

TUNNEL AND SHAFT CONSTRUCTION

23.1 GENERAL

23.1.1 **Requirement.** In addition to the safety requirements set forth in this section and other parts of this manual, tunnel and shaft excavation and construction shall be performed in compliance with applicable provisions of the contract. No underground-related work shall commence until all aspects of the operation have been covered in an acceptable safety program, or a detailed supplementary submittal specific to underground operations. (Refer to subsec. 2.7 for more detailed requirements.)

23.1.2 **Employee identification.** Entrances to all underground facilities shall have a check-in and checkout system that provides the contractor with an accurate record of each person underground. The system shall incorporate means for identifying each individual and general location. General locations may be defined as heading, train crew, track crew, maintenance area, storage area, survey stations, etc. Additionally, all personnel when underground shall carry or wear a positive means of identification, such as a metal disk or tag.

23.1.3 **Illumination.** Underground lighting and illumination intensities shall be provided as set forth in paragraph 7.14.3. Light fixtures shall be nonmetallic and lighting conductors shall be supported on insulators located on the side of the tunnel or shaft opposite the firing line. Only acceptable portable lighting equipment shall be used within 50 feet of any underground heading during explosives handling.

23.1.4 **Electrical equipment.** The underground electrical distribution system shall be designed and certified as meeting good practice and applicable standards by a registered professional engineer knowledgeable in underground wiring practices. All electrical equipment shall be installed and maintained to meet the applicable requirements set forth in section 12. Only dry-type transformers shall be permitted underground and they shall be protected from possible damage. Powerlines shall be separated or insulated from air and waterlines, metal ducts, telephone lines, and blasting lines.

23.1.5 **Bonding and grounding.** Air and water piping, metal vent pipe, rails, and similar conductive devices shall be grounded and bonded at the portal or shaft head and at intervals not exceeding 1,000 feet.

23.1.6 **Communications.** A telephone system or an equivalent powered communication system shall be installed between the tunnel heading and portal, shaft bottom and shaft head and first aid station. Powered communication systems shall be independent of the tunnel or shaft power supply and shall be installed so that failure or disruption of any one station will not

disrupt the operation of any other station. Communication systems shall be tested at the beginning of each shift and at shorter intervals when necessary to ensure reliability. No employee will work alone unless within voice communication distance of another employee or provided with an appropriate powered communication system for obtaining instructions and emergency assistance.

23.1.7 Blasting. Blasting and explosive-handling operations shall conform to the requirements set forth in section 24.

23.1.8 Personal protective equipment. Personnel entering underground workings shall wear, as a minimum, hardhats conforming to subsection 8.2, appropriate eye protection conforming to subsection 8.3, and foot protection conforming to paragraph 8.6.6. Personnel entering wet areas shall wear rubber footwear described in paragraph 8.6.6, underground type rain gear, and eye, face, and head protection described above. Other personal protective equipment described in sections 7 and 8 shall be provided and worn as applicable.

23.2 EMERGENCY PROVISIONS

23.2.1 Evacuation plan. Emergency evacuation plans, including provisions for rescue equipment, shall be developed and posted at the portal or shaft head. Employees shall be instructed in the emergency procedure.

23.2.2 Self-rescuers. NIOSH- and/or MSHA-approved self-rescuers shall be available at headings, shaft bottoms, and all other underground work areas. There shall be at least one readily available self-rescuer for each employee and visitor. Employees and visitors shall meet training requirements of paragraph 8.4.8. Self-rescuers shall be maintained in accordance with the manufacturer requirements.

23.2.3 Emergency hoist. An emergency personnel hoist acceptable shall be provided for shafts over 50 feet in depth. The hoist shall, as a minimum, be designed so that the load hoist drum is powered in both directions and a brake is automatically applied upon power release or failure. The emergency hoist is required in addition to the primary hoist required in subsection 23.12.

23.2.4 Rescue crews. An emergency plan covering the possible emergencies requiring the use of a rescue crew shall be developed as part of the Emergency Plan required by section 6. The plan shall include the equipment, training, and organization of the rescue crews.

a. Tunnel and shaft operations employing 25 or more employees at one time underground shall have at least 2 rescue crews of at least 5 men each. One crew shall be on the job site, or within 1/2-hour travel time from the portal and the other within 2-hour travel time.

b. Not less than one crew of at least five employees shall be organized and trained as a rescue crew, or arrangements made in advance with a locally available rescue service, for

smaller jobs. The rescue crew or rescue service is to be located on the job site or within 1/2-hour travel time.

c. New crew members shall be thoroughly instructed upon assignment to the rescue crew, and refresher training for the full crew conducted at least every 6 months.

d. Rescue team members shall be instructed and trained in rescue procedures, in the use and care of oxygen breathing apparatus, and in the use of firefighting equipment. Oxygen-breathing apparatus will be required unless in the development of the emergency plan, analysis specifically indicates it is not required, and that the use of self-contained breathing apparatus is sufficient. Breathing apparatus shall be kept in good repair and ready for use at all times. A sufficient supply of spare breathing apparatus, replacement parts, and regenerating material or air cylinders shall be maintained.

23.2.5 Emergency lighting. Each employee and visitor entering underground working shall be provided and carry an MSHA-approved portable hand or cap lamp. Providing hand or cap lamps does not reduce the lighting requirements contained in subsection 7.14.3.

23.2.6 Designated person. At least one designated person shall be on duty above ground when personnel are underground. The person shall be familiar with operating features of the lighting and ventilation system and the procedures for obtaining emergency service. The designee shall remain in contact range of the communication system annunciator.

23.3 VENTILATION

23.3.1 Requirement. All areas of tunnels, shafts, and other underground workings shall be mechanically ventilated with clean, respirable, nonrecirculated outside air. The ventilation system(s) shall be placed in operation prior to personnel entering any underground workings and remain in operation until all personnel have left the area serviced by the system.

23.3.2 Ventilation system design requirements. The system(s) design criteria, specifications, and appropriate drawings shall be submitted prior to acquiring or installing the system. The following specific design features shall be incorporated in all ventilation systems:

a. All airflows shall be mechanically induced. Providing required air quantities by natural ventilation methods is prohibited.

b. Primary ducts and fans shall be constructed of noncombustible metallic materials. Short noncritical sections of expandable-type ducting can be used in secondary systems.

c. Electric motors, fans, drives, and auxiliary equipment, including wiring, starters, and controls, shall be class 1, division 1. The system shall be designed, installed, and maintained in explosion-proof condition and capable of operating in an explosive atmosphere.

- d. Ventilation fans should be selected so noise levels attributable to fan operation do not exceed 90 dBA when measured at the closest point of employee exposure.
- e. System airflows, secondary systems excepted, shall be reversible from a surface location. The reversing feature shall incorporate a control system that does not require rewiring of fans or electrical circuits to accomplish the reversing sequence.
- f. Primary ventilation systems shall be designed to operate in the exhausting mode.
- g. Primary duct system inlets shall be maintained within three duct diameters of the tunnel face or shaft bottom when operating in exhaust and within 10 duct diameters of the tunnel face or shaft bottom when operating on blow. In conventional drill and blast tunnels, it may be necessary to install a supplemental ventilation system to ensure the minimum ventilation rate is maintained to the tunnel face or shaft bottom during all portions of the excavation cycle. "Blow Joes" or similar type recirculating devices do not meet this requirement.
- h. Ventilation air shall be heated or cooled as necessary to ensure air temperatures at worksites are maintained between 40 EF and 100 EF.
- i. Ventilation system design capacities (CFM) shall be the greater of:
 - 1. The total rate (CFM) required for all MSHA-approved diesel engines operating underground.
 - 2. The total rate (CFM) required for all non-MSHA-approved equipment. Non-MSHA-approved diesel equipment shall meet the requirements of subsection 23.6.
 - 3. The total rate (CFM) required to control airborne contaminants or toxic and flammable gas/vapor within prescribed limits and/or values specified or referenced in this section and section 7.
 - 4. The rate (CFM) required to maintain a minimum air velocity of 100 feet per minute (FPM) over the gross bore area of all sections of the underground workings.

23.3.3 Air volume measurements. The employer shall develop and implement a procedure for ensuring design airflows being maintained in all sections of underground workings. The procedure as a minimum shall require that:

- a. Airflows be determined immediately after system installation or modification that could significantly affect airflows (i.e., adding new fans, repairing fans, changing ducting arrangements).
- b. Airflows in primary ventilation systems be continuously monitored with direct readout instruments containing low air volume alarms.

- c. Airflows in congested tunnel areas (i.e., headings, by rapid excavation machines) be determined by pitot tube traversing of the duct system supplying or exhausting air from the area. (Refer to ACGIH publication, "Industrial Ventilation," for acceptable equipment and methods for air volume determinations.)
- d. All data obtained by measurement, including the date, place, time, instrumentation, calculations, results, and name of test personnel is maintained on the surface and available for review.

23.4 AIR QUALITY

23.4.1 **Requirement.** Underground air quality shall meet the following specifications:

- a. Oxygen concentrations shall be between 19.5 percent and 22.0 percent
- b. Carbon monoxide concentrations shall not exceed twenty five p/m (parts per million) (0.0025 percent)
- c. Carbon dioxide concentration shall not exceed 5000 p/m (0.5 percent)
- d. Nitrogen dioxide concentration shall not exceed 3 p/m (0.0003 percent)
- e. Hydrogen sulfide shall not exceed ten p/m (0.001 percent)
 - 1. Whenever hydrogen sulfide levels exceed 5 p/m (0.0005 percent) tests for hydrogen sulfide shall be conducted in the affected areas every 4 hours.
 - 2. If hydrogen sulfide levels exceed 10 p/m (0.001 percent), a continuous sampling hydrogen sulfide indicator with alarm shall be used to monitor the affected work area.
 - 3. If the concentration of hydrogen sulfide exceeds 10 p/m (0.001 percent) TWA for an 8-hour period, steps shall be taken to increase ventilation to reduce the concentration.
- f. Methane gas shall not exceed 20 percent of lower explosive limit:
 - 1. Whenever 5 percent or more of the lower explosive limit for methane or other flammable gases is detected, steps shall be taken to increase the ventilation rate or other steps shall be taken to lower the methane concentration.
 - 2. Whenever 10 percent or more of the lower explosive limit for methane or other flammable gases is detected in the vicinity of welding, cutting, or other hot work, such work shall be suspended.

3. Whenever 20 percent of the lower explosive limit for methane or other flammable gases is detected, all employees except those necessary to eliminate the hazard shall be evacuated and electrical power except for explosion proof pumps and ventilation equipment shall be disconnected.

g. Other flammable gases/vapors shall not exceed 20 percent of lower explosive limit.

h. Other airborne contaminants including dust shall not exceed limits prescribed in subsection 7.2.

23.4.2 Quantitative sampling of underground environments. Quantitative sampling of underground environments shall be conducted by a competent person. (One who through education, experience, and training can, using acceptable scientific instruments and methods, determine the quality of air in underground environments.) Quantitative sampling shall be conducted as follows:

a. While the tunnel is being excavated - at least once each 4 hours and prior to reentry into face area after each blast - the environment in the face area shall be tested first for oxygen concentration and then for flammable gas/vapors, carbon monoxide, and nitrogen dioxide.

b. At least once each day, all working environments shall be tested for oxygen concentration, flammable gas/vapors, carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other appropriate gases/vapors.

c. Ten days following start of underground operations, and at 90-day intervals thereafter, or within 10 days following major changes in tunnel excavation methods or major modifications to ventilation systems all working environments near dust-producing operations shall be sampled for applicable airborne particulates. Within 10 days following the sampling date, the employer shall furnish a full report of the sampling method and analysis and an evaluation of the environmental conditions to the affected employees.

d. Environmental sampling data, including procedures, equipment, personnel, dates, and results, shall be logged and filed at a surface location and be available for review.

23.4.3 Specialized instrumentation. In addition to quantitative sampling requirements of paragraph 23.4.2, specialized direct reading instruments for determining concentration of flammable gases/vapors shall be installed by the employer as follows:

a. All rapid excavation machines shall be equipped with a multi-sensor continuous flammable-gas/vapor detector designed to shut down excavation operations when gas/vapor concentrations reach 20 percent of the lower explosive limit. One sensor shall be located at the dust shield in close proximity to the conveyor belt opening. One sensor shall be located at the operator's station and one in the primary duct of the exhaust mode ventilation system.

b. In conventional (drill and blast) operations, an automatic multi-sensor continuous gas detector shall be installed near the tunnel heading or shaft bottom. The unit shall be equipped with visual and audio alarm components capable of alerting employees working at the heading or bottom that flammable gas/vapor concentrations have exceeded 20 percent of the lower explosive limit. One sensor shall be located in the primary duct of an exhausting ventilation system and at least one located in the general tunnel area within 30 feet of the face. All sensors installed in the tunnel proper shall be located as near the crown as practical.

c. Machine excavation operations, other than described in subparagraph "a," require similar detection system with one sensor effectively placed to detect flammable gas/vapor concentrations near the cutter head.

23.4.4 Suspensions of operations. All underground operations shall be suspended and all employees removed from underground working whenever flammable gas/vapor concentrations exceed the acceptable levels set forth in paragraph 23.4.1. Reentry, except for rescue operations, is prohibited until authorized in writing by the CO or office head. Written authorization shall not be provided until:

a. The employer has engaged the services of a professional engineer experienced in gaseous tunneling/mining operation.

b. The engineer has, after onsite investigation and testing, developed a written detailed procedure for safely reentering the underground workings and resuming operations.

c. The procedure complies with all requirements of these standards and the regulations of Federal and State entities having jurisdiction.

23.5 DUST CONTROL

23.5.1 Requirement. All drilling and excavation operations shall be carried out in a manner that meets the requirements of this subsection and controls airborne dust concentrations within limits prescribed in subsection 7.2. Required quantitative testing of underground environments and operations to ensure effectiveness of dust control methods are detailed in subparagraph 23.4.2.c.

23.5.2 Drilling. Rotary and percussion drills shall be equipped with water or chemical dust-control systems or other control systems.

23.5.3 Machine excavation. Tunnel boring machines or other excavating machines shall be equipped with an effective dust-control system(s) prior to installation. The system shall be capable of controlling the dust concentrations within the specified safe hygienic limits. The system shall be routinely maintained and tested to ensure its effectiveness.

23.5.4 Muck piles. Muck piles shall be kept wet to reduce dust concentrations.

23.6 INTERNAL COMBUSTION ENGINES

23.6.1 Requirement. Internal combustion engines, other than approved diesel-powered equipment, shall not be used underground.

a. MSHA-approved or -certified diesel equipment shall be approved or certified under the provisions of 30 CFR Part 32 or 30 CFR Part 36 (formerly schedules 24 and 31) and, when applicable, a permit shall be obtained from the state entity having jurisdiction. Written approvals or certifications shall be provided prior to the equipment being taken underground.

b. Non-MSHA-approved diesel equipment shall be certified by the employer to be equivalent to MSHA-approved equipment and shall meet the following requirements:

1. The fuel injection system of the engine shall be so constructed that the mechanism controlling maximum fuel injection may be fixed permitting adjustment only by breaking a seal or by altering the design.
2. At maximum fuel air adjustment under normal operating conditions and within the rated output range of the engine, the undiluted exhaust gas shall not contain more than 2,500 p/m carbon monoxide, and no more than 2,000 p/m oxides of nitrogen.
3. Provisions shall be made to dilute the exhaust gas with air before it is discharged into the surrounding tunnel atmosphere. The quantity of diluting air shall be such that the discharged mixture of exhaust gas and air shall not contain more than 100 p/m carbon monoxide, 25 p/m of oxides of nitrogen, 10 p/m of aldehydes, and 2 milligrams per cubic meter of exhaust gas particulate emissions.
4. Provisions shall be made to cool the engine exhaust prior to releasing it into the surrounding tunnel atmosphere. The exhaust gases shall be cooled so as not to exceed 160 EF prior to being released from the exhaust system.

23.6.2 Ventilation requirements. Ventilation requirements (CFM) incident to the use of diesel-powered equipment underground shall comply with the following, but never less than those required by subsection 23.3.

a. The cumulative MSHA-approved ventilation rate for all diesel-powered equipment used underground.

b. For non-MSHA-approved equipment a ventilation rate (CFM) adequate to dilute all gaseous exhaust contaminants to below the prescribed limits and/or values specified or referenced in section 7 and subsection 23.4, and to reduce the particulate emissions to below 1 milligram per cubic meter. In no case shall the required ventilation rate be less

than 150 cubic feet per minute multiplied by the manufacturer's rated horsepower of all engines when operating at maximum fuel/air ratio.

23.6.3 Maintenance and testing. Diesel equipment shall be inspected and maintained in accordance with instructions furnished by the manufacturer. The operation and maintenance of diesel equipment shall comply with the MSHA guidelines in 30 CFR 32.9 recommendation on the use of mobile diesel powered equipment in non-coal mines. Records of inspections and maintenance shall be maintained.

23.7 NOISE CONTROL

23.7.1 Requirement. A thorough noise survey of all underground operations shall be conducted by a qualified person using an approved type 2 sound level meter. Should the sound levels exceed the permissible noise exposures set forth in paragraph 7.7.2, the employer shall initiate and carry out a hearing conservation program in accordance with the requirements of paragraph 7.7.4.

23.8 FIRE PREVENTION AND CONTROL

23.8.1 Requirement. In addition to the requirements set forth in section 10, the following requirements shall apply to all underground operations.

23.8.2 Heating. LPG and natural gas heaters are prohibited underground.

23.8.3 Gasoline, diesel, and LPG. Gasoline and liquefied petroleum gases shall not be permitted underground. No more than 1 day's supply of diesel oil shall be permitted underground. Piping of diesel fuel or combustible liquids from the surface to below ground is prohibited.

23.8.4 Welding and cutting. Welding and cutting operations underground shall comply with section 16 and this paragraph. Acetylene, MPS (methyl acetylene propadiene stabilized) gas may be used underground for welding, cutting, and hot work. No more than the amount of fuel gas and oxygen necessary for work under progress for that shift shall be permitted underground. Prior to welding or cutting, a competent person shall determine that the atmosphere does not exceed the flammable gas/vapor or oxygen limits of subsection 23.4.

23.8.5 Lubricants. Oil, grease, and diesel fuel stored underground shall be kept in tightly sealed containers in fire-resistant areas at least 300 feet (91.44 meters) from explosive magazines and 100 feet (30.48 meters) from shaft stations, inclined passageways, and major electrical installations. Only electrical lighting systems approved for class I, division 2 locations shall be installed in the storage area.

23.8.6 Hydraulic fluids. Fire-resistant hydraulic fluids approved by a recognized authority, such as Underwriters Laboratories, Inc., or Factory Mutual, shall be used in hydraulically-

actuated machinery and equipment, unless the equipment is protected by a fire protection system.

23.8.7 Belt conveyors. Fire extinguishers of at least 2-A:40-B:C units shall be provided at the head and tail pulleys and at 300-foot intervals along the belt line. A device shall be installed on the conveyor drive system that will automatically disconnect power to the drive unit if the conveyor stalls.

23.8.8 Portal structures. All structures erected within 100 feet of a tunnel portal or shaft entrance shall be of fire-resistive construction. Flammable material storage areas shall be at least 200 feet from the portal or shaft entrance. Combustible or flammable material shall not be permitted within 100 feet of the portal or shaft entrance or main fan installation, or in a location where in case of a spill or leak that the material will flow into the portal area.

23.8.9 Fire suppression systems for diesel-powered equipment. All diesel-powered equipment operated underground shall be equipped with all of the following:

- a. A minimum of one 2-A:40-B:C dry chemical fire extinguisher mounted in such a manner as to be accessible from ground level.
- b. A dry chemical pre-engineered fixed nozzle-type fire suppression system. The system shall be specifically approved for the respective service and potential hazard by Factory Mutual or other nationally recognized independent testing laboratory. The design, installation, operation, and maintenance of the system shall be in accordance with the testing laboratory's recommendation. The system, where applicable, shall conform to NFPA Standard No. 17, "Dry Chemical Extinguishing System," and requirements of the authority having jurisdiction. Manual system actuators shall be accessible from ground level and within reach of the operator when seated in the operating position.

23.9 EXCAVATION OPERATIONS

23.9.1 Requirement. Employees shall be trained in the safety requirements to be followed for the method of excavation to be used, including equipment to be used, ground support systems, and materials handling systems prior to the start of excavation operations.

a. Drilling Operations

1. *Examination and scaling.* Prior to commencing the drill cycle, the face and lifters shall be examined for misfires and, if found, they shall be removed before drilling. Lifters shall not be drilled through loose rock or water. The heading, including the face, shall be inspected for loose rock and scaled prior to mucking and drilling. Employees engaged in these activities will be protected from dislodgments by location, ground support, or other equivalent means.

2. *Equipment inspection.* Drilling equipment shall be inspected each shift and defects affecting safety shall be corrected before the equipment is used.

3. *Drill jumbos.* On jumbo decks over 6 feet in height, removable guardrails with pipe uprights and chain handrails, or equivalent protection, shall be installed on the open sides and back. Safe access to the deck shall also be provided and the decks covered with solid nonslip decking. When jumbos are being moved, riders shall not be permitted on the deck unless assisting the operator.

(a) Jumbos shall be chocked to prevent movement while employees are working on them.

(b) Walking working surfaces of jumbos shall be maintained to prevent the hazards of slipping, tripping and falling.

4. *Moving drills.* Drill steel, tools, mast, and other equipment shall be secured in a safe position when a drill is being moved to another area. Receptacles or racks shall be provided for drill steel stored on drill jumbos.

5. *Drill masts.* Employees shall not be permitted on the drill mast when the drill bit is in operation.

6. *Column drills.* Drills supported on columns shall be anchored firmly prior to operation and shall be retightened frequently during operation.

7. *Startup warning.* Before the drill cycle is started, a warning shall be given to employees working below the jumbo deck.

8. *Lifting material and equipment.* A mechanical means shall be provided to raise heavy materials and equipment to the top decks of jumbos over 4 feet in height.

9. *Airhose.* All airhose exceeding 0.5-inch inside diameter shall be secured at each connection and at the drill with clips and wire rope or chain lashings or equivalent safety device.

23.9.2 Mechanical Excavation

a. *Mechanical Hazards.* An audible warning shall be sounded before starting excavating or conveying machinery. Excavating machines shall be equipped with dead man controls. Adequate guarding shall be provided where workers are exposed moving parts or to hydraulic lines operating at temperatures in excess of 160 EF.

b. *Lockout.* In addition to requirements found in section 15, a means to lock out all power sources from the mechanical excavating equipment shall be provided. Tunnel-boring machines where employees may be required to work between the face and the cutter head

shall be provided with a positive mechanical block to prevent movement of the cutter head in addition to the provision to lock out the power.

c. *Examination.* A through examination of the heading shall be made before starting excavation equipment.

23.10 GROUND SUPPORT

23.10.1 **Tunnel portals.** Rock faces above and adjacent to portal areas shall be kept thoroughly scaled, and all loose or overhanging rock removed. Chain link fabric shall be provided on rock faces subject to spalling or raveling. A fire-resistive protective canopy shall be provided at all tunnel portals. It shall project at least 15 feet from the portal face and be designed to withstand falling earth or rock.

23.10.2 **Inspection and scaling.** Tunnels and shafts where employees are working shall be inspected by a competent person at least once a shift, and scaled and supported as required. Scaling bars shall be provided and maintained in good condition. The entire tunnel, including roof and walls, shall be inspected at least weekly by a competent person. Weekly inspection records shall be maintained on the surface.

23.10.3 **Loose ground.** Loose rock and earth shall be removed or supported. Employees scaling or installing supports shall work from supported areas or be protected by spiling, crown bars, shielding, or other equivalent protective systems.

23.10.4 **Rock bolting.** Rock bolt support systems shall be designed by a professional engineer competent in the field. Torque meters and torque wrenches shall be available where rock bolts are used. Torque testing and retightening intervals shall be established by a competent person, on the basis of rock conditions and existing vibration sources.

23.10.5 **Damaged tunnel supports.** Damaged or dislodged tunnel supports, of any description, shall be immediately repaired or replaced. Whenever possible, new supports shall be installed prior to removing the damaged supports.

23.10.6 **Anchorage.** All sets, including horseshoe-shaped or arched rib steel sets, shall be designed and installed with the bottoms sufficiently anchored to prevent movement. Lateral bracing shall be installed between sets to stabilize the support.

23.10.7 **Wood supporting structures.** Use of timber supports and/or wood lagging are prohibited.

23.11 TRANSPORTATION AND HAULAGE

23.11.1 **Requirement.** The employer shall develop a complete set of operating rules for all types of haulage equipment. A copy of these rules shall be provided to and discussed with all

personnel prior to their going underground. Operational changes affecting the rules shall not be implemented until the rules have been changed.

23.11.2 Inspection. All haulage equipment shall be maintained in safe operating condition and inspected at the beginning of each shift by a qualified person. Equipment defects affecting safe operation shall be corrected before the equipment is used.

23.11.3 Rail haulage systems

a. *Locomotives.* Locomotives, in addition to meeting requirements of subsection 23.6, shall be equipped with (1) a braking system(s) capable of stopping and holding a loaded train on any section of track, (2) headlights, backup light, audible warning device, continuous revolving flashing amber light visible in all directions, (3) seats for operator and all passengers, (4) adequate platforms and handholds for train crew, (5) rerailers and jacks, (6) deadman controls, and (7) falling object protection in accordance with latest revision of 29 CFR 1926, Subpart S, "Tunnels and Shafts, Caissons, Cofferdams, and Compressed Air."

b. *Man-haul units.* Man-haul (man cars) units shall be (1) totally enclosed except for doors, small windows, and ventilation openings, (2) equipped with seats for all passengers, adequate access devices, and safety chains in addition to safety coupling devices, and (3) used only to transport personnel, their personal equipment, and small secured tools. Man-haul trips shall consist of engine and man-haul car(s) only. Man-haul cars shall be pulled when occupied. Incidental transporting of personnel between shift change can be on locomotive seats or sitting in specially equipped empty muck cars having adequate headroom. Muck cars carrying personnel shall be pulled and equipped with safety chains.

c. *Haulage cars.* Mine dump cars shall be equipped with automatic safety couplings. Cradle or bottom dump cars shall be equipped with a positive-locking device to prevent accidental dumping. Tiedown chains and/or bumper blocks shall be provided and used to prevent overturning of cars dumped by hand.

d. *Tracks.* Rails shall be installed and maintained in a manner that prevents shifting or excessive settlement. Rails shall be anchored to prevent unsafe separation of rails and gauged during laying operations and regularly while in use. Berms, bumpers, blocks, safety hooks, or equivalent means shall be provided to prevent overtravel or overturning at dumping areas.

e. *Operations.* Materials to be hauled shall be loaded and secured to prevent sliding or dislodgement. Only small hand tools, lunch pails, or similar light items may be carried on top of locomotives, and the top of the locomotive must be designed or modified to retain them while traveling. Parked equipment shall be chocked, blocked, or have the brakes set to prevent inadvertent movement.

23.11.4 Nonrail-type haulage systems. Nonrail-type haulage systems shall comply with the following applicable requirements:

- a. Rubber-tired or crawler equipment and operations shall comply with applicable requirements of this section and section 19.
- b. Conveyor systems equipment and operation shall conform with applicable requirements of this section and section 18.

23.12 SHAFTS

23.12.1 Requirement. In addition to other applicable provisions of this section, the following requirements shall apply to the excavation of vertical and inclined shafts. Shafts over 5 feet in depth that employees must enter shall be supported. The method of support shall be determined by a competent person.

23.12.2 Access. All shafts shall be provided with a protected manway designed to permit safe access and egress to and from the shaft bottom. Hoisting systems designed, installed, operated, and maintained as set forth in paragraph 23.12.4b may be used to transport personnel.

23.12.3 Guards. The shaft opening shall be protected with totally enclosed perimeter guarding, equivalent in height to a standard guardrail. The ground adjacent to the top of the shaft collar shall be sloped away from the shaft to prevent the entry of liquids and an effective barrier shall be in place to prevent mobile equipment from entering the shaft accidentally.

23.12.4 Hoisting systems

a. *Cranes, derricks.* Cranes, derricks, or similar equipment shall not be used as the primary hoisting system to raise or lower personnel. Cranes, derricks or similar equipment meeting the requirements of this section may be used to meet the requirement for an emergency hoisting system. Cranes shall not be used to raise or lower muck or concrete buckets, or similar devices used for removing excavated material or placing concrete except in shafts less than 75 feet (22.86m) in depth. Cranes may be used to raise and lower construction materials or equipment that cannot be safely handled by the hoisting system required by subparagraph 23.12.4b. Cranes used in this service will conform with applicable provision of section 18 and all of the following requirements.

1. Primary and secondary hoisting lines shall be equipped with planetary or worm gears, torque convertors, automatic braking systems, or other equivalent systems that prevent the loadlines from being placed in a free wheeling or neutral position controlled by manual brake and/or dogs only.
2. Hoisting lines(s) shall be equipped with an anti-two-blocking device or two-block damage prevention feature, and a limit switch to prevent overtravel at the bottom of the shaft. At least two full wraps of wire rope shall remain on the drum at all times.

3. The crane shall be inspected by a competent person at the beginning of each shift, and each time it is set up at the worksite. The crane shall be given a full cycle operational test lift prior to initial use at the shaft site and each time it is reset at the site.

b. *Primary hoisting system.*

1. **General requirement.** A stationary hoisting system meeting the requirements of this subsection and applicable provisions of section 18, and ANSI A10.22, "Safety Requirements for Rope-guided and Non-guided Workmens' Hoists," shall be installed at all shaft sinking operations 75 feet (22.86m) or more in depth. All stationary hoisting systems shall be designed by a professional engineer competent in the field. In case of conflicts between these and referenced standards, the more stringent shall prevail.

2. **Specific requirement.** The stationary hoisting system shall meet applicable ANSI Standards, the requirements of the State having jurisdiction, and the following specific requirements:

(a) **Personnel hoisting.** The primary hoisting system may be used to hoist personnel in attached cages or manskips meeting requirements of referenced ANSI Standards or in buckets suspended beneath crossheads operating on rail or rope guides, provided: (1) the sides of the bucket are at least 4 feet in height and not less than 1/16-inch-thick steel; (2) emergency chains, slings, or double clevis pins are used between the lower end of the hoisting rope and the bucket to prevent the bucket from falling in event of ring bolt or clevis pin failure; (3) a bonnet is provided that covers the top in such manner to afford protection from falling rock or other objects; (4) the bonnet is the equivalent of two steel plates 3/16 inch in thickness, sloping toward each side and arranged to permit safe egress from the bucket; (5) the speed of the personnel platform shall not exceed 200 feet per minute; and (6) governor controls set for 200 feet per minute shall be installed in the control system and shall be used during personnel hoisting.

(b) **Hoist motors.** The hoist motor shall be so designed that the load is powered up and down through the gears. There shall be no friction gearing or clutch mechanism by which the motor or other power source can be disconnected from the hoist drum. When the control is brought to the "stop" position, or should the motor stop, the load shall stop and remain in the stopped position.

(c) **Hoist controls.** The hoist control shall be designed to return to the "stop" position when the hand of the operator is removed from the control lever. The brakes shall be automatically applied and the power cut off whenever the control lever is in the stop position. All hoist controls and the emergency power cutoff shall be within reach from a single operating position.

(d) **Guides.** Shafts over 75 feet (22.86m) in depth shall be equipped with guide rails or guide cables to prevent the cage or bucket from swaying.

(1) When sinking shafts over 75 feet (22.86m) in depth, the guide rails or cables shall be maintained as closely as possible to the bottom of the shaft. In the case of rail guides, they shall be maintained within one rail length of the bottom. A safe means of access shall be provided from the bottom landing to the bottom of the shaft.

(2) When sinking shafts less than 75 feet (22.86m) in depth, cages, skips, and buckets that may swing, bump, or snag against shaft sides or other structural protrusions shall be guided by fenders, rails, ropes, or a combination of those means.

(3) Cages, skips, and buckets in all completed shafts shall be rope- or rail-guided for the full length of their travel.

(e) **Broken-rope safety.** Cages, skips, or buckets operating on guides or guide cables in shafts over 75 feet (22.86m) in depth shall be equipped with a broken-rope safety device, or equivalent, that will stop and hold a 150 percent of rated capacity in event of a hoisting cable failure.

(f) **Limit stops.** Hoists shall be equipped with approved-type limit switches which will automatically cause the cage or bucket to stop at the limits of travel.

(g) **Communications.** Hoist operators shall be provided with a closed-circuit communications system to each landing station, with speaker-microphone so located that the operator can communicate with individual landing stations during hoist use.

(h) **Performance inspections and tests.** Following installation and prior to use, at 6-month intervals thereafter, and after modification or repair of critical components each hoist shall be inspected and load tested under the direction of the design engineer or a competent qualified person certified by the design engineer to conduct such inspections and tests. A comprehensive report detailing the required inspections and test procedures and results, signed by the engineer or his/her designee, and shall be maintained. The tests shall include a broken rope drop test to verify that safety clamps function properly and that the guide ropes/rails, their supports and the bucket/cage are able to withstand the imposed load.

(Note: One method for conducting such tests is detailed in ANSI A10.5, "Safety Requirements for Material Hoists," under para. 11.9.6.1.)

Further, the hoist shall be performance tested with a test load of 125 percent through all limits of travel to ensure satisfactory operation of limit switches, speed indicators, braking systems, and controls.

(i) **Periodic inspection and test.** A competent person shall visually check all hoisting machinery equipment, anchorages, and hoisting rope at the beginning of each shift and during hoist use, as necessary. Each safety device shall be checked by a competent person at least weekly during hoist use to ensure suitable operation and safe condition. Periodic inspections and tests shall conform to the design engineer's recommendations. (See para. 18.1.4.)

c. *Overhead protection.* No material or tools shall be hoisted or lowered while men are working at the bottom of a shaft, unless a barrier of adequate strength is installed to protect them from falling objects or material. No load, cage, skip, bucket, etc., shall be lowered directly to the bottom of a shaft when men are working there. All such equipment shall be stopped at least 15 feet above the bottom of the shaft and remain there until the signal to lower is received from a signaller at the bottom of the shaft.

23.12.5 **Suspended or movable work platforms.** Suspended or movable work platforms shall be designed, inspected, and tested in accordance with applicable provisions of subparagraph 23.12.4.b or subsection 18.10. The term "platform" in this subsection is considered synonymous with the terms skips or cage, in referenced subparagraphs, subsection, or standards.

23.12.6 **Small-diameter shafts.** Small-diameter shafts, such as manholes, wells, or test pits in which employees are required to enter, shall be provided with a steel casing, concrete pipe, timber cribbing, or other support adequate to retain surrounding earth. See subsection 7.8 for additional requirements.

23.12.7 **Inspection.** Following a blast, the walls, ladders, supports, blocking, and wedges shall be checked to determine if they have loosened. If they are found to be loose or unsafe, repairs shall be made prior to continuing work in the shaft.

23.13 TUNNELING IN SOIL

23.13.1 **Support.** When excavated by conventional methods, the excavation shall not be extended more than 2 feet in advance of the tunnel supports. When continuous mining machines are used, the support shall be kept within 4 feet of the face or shield. No employees shall be permitted under unsupported or unshielded sections of the tunnel.

23.13.2 **Voids.** Voids behind ring beams, liner plates, or other supports shall be filled, blocked, or braced to prevent caving.

23.13.3 **Design of support.** Support systems for tunnels excavated in soil shall be designed by a professional engineer competent in the field.

23.14 COMPRESSED-AIR WORK

23.14.1 **Requirement.** The employer shall comply with the requirements set forth in 29 CFR 1926.803, "Compressed Air," when operations involve work in a compressed-air environment.

Section 24

BLASTING OPERATIONS

24.1 GENERAL

24.1.1 Requirement. In addition to the requirements of this section, the transportation, handling, storage, and use of explosives shall be subject to provisions of Subpart U, "Blasting and Use of Explosives," of 29 CFR Part 1926 and Section 109, "Explosives and Blasting Agents," of 29 CFR Part 1910, and regulations of Department of the Treasury contained in 27 CFR Part 55, "Commerce in Explosives." In case of conflicts, the more stringent will prevail.

24.1.2 Competent supervision. The transportation, handling, storage, and use of dynamite and other explosives, including blasting agents, shall be directed and supervised by persons of proven experience and competency in blasting and use of explosives. Written evidence of the blasting supervisor's past experience shall be furnished to the employer.

24.1.3 Qualifications. A blaster shall be qualified, by reason of training, knowledge, or experience, in the field of transporting, storing, handling, and use of explosives, and have a working knowledge of State and local laws and regulations which pertain to explosives. Blasters shall be required to furnish a Federal, State, or local license or certificate, or proof of formal training attended within the last 5 years, or three recommendations from past employers and/or manufacturer's of explosives testifying to the blasters knowledge and ability to perform in a safe manner the type of blasting that will be required.

24.1.4 Permission required. Permission shall be obtained from the employer prior to bringing any explosives or blasting agents on the jobsite. Such permission will not be given unless the employer safety plan required by subsection 2.7 or a subsequent supplementary plan includes a comprehensive detailed blasting program. The required program must, as a minimum, show proposed methods and procedures for conforming with these and referenced standards and regulations including:

- a. Method and equipment for transporting explosives and detonators
- b. Type and location of storage facilities
- c. Type and quantity of explosives and detonators
- d. Primer assembly procedure and location
- e. Employee training programs
- f. Provisions for protecting persons, structures, private and public property
- g. Provisions for developing and distributing a daily blasting plan covering hole diameter, spacing, loading, and delay patterns
- h. Provisions for disposal of explosives and blasting agents and associated materials

24.1.5 Security and inventory. The contractor shall provide such reasonable and adequate security as is necessary to prevent loss or theft of explosives. He shall maintain an inventory of all explosives on the jobsite, including a record of explosives received and withdrawn from the magazines. Such records shall be available and any loss or theft promptly reported to the appropriate authorities.

24.1.6 Notification of owners. Blasting operations in the immediate vicinity of buildings, public roads, overhead powerlines, utility services, or similar facilities shall not be undertaken until the owners and/or the operators have been notified and all necessary precautions taken for safe control of the blasting operations.

24.1.7 Smoking restrictions. Smoking, firearms, matches, open flame lamps, fire, heat-producing devices, and sparks shall be prohibited in or near explosive storage sites or in areas where explosives are being handled, transported, or used.

24.1.8 Thunderstorms. The handling or use of explosives shall be discontinued during the approach and progress of a thunderstorm. All persons shall be removed from the danger areas to a place of safety during such periods. The employer shall acquire and use an approved-type lightning warning device capable of detecting atmospheric conditions that could produce lightning. Warning devices shall be acceptable to the COR or office head prior to installation.

24.1.9 Vibration and damage control. Blasting in or adjacent to dams and appurtenant structures (also cofferdams, buildings, and other facilities susceptible to vibration and/or airblast damage) shall be carefully controlled to eliminate any possibility of damage. Where required by the specifications, the CO, or the office head, the employer shall submit for review and approval a vibration and damage control plan prepared by a recognized blasting specialist. The plan shall incorporate provisions for monitoring blasts with calibrated seismographs containing triaxial orthogonal velocity transducers with a flat frequency response from 2 to 200 hertz to be placed in designated locations and/or structures as specified by Reclamation. The maximum peak particle velocity as recorded by the seismographs at the designated structure or locations shall not exceed 1 inch per second, unless otherwise specified by Reclamation. The seismograph recording or seismogram shall be a real-time direct readout permanent record of the vibration measurements and copy shall be submitted.

Airblast shall be controlled so it does not exceed 128 decibel linear-peak at designated locations and/or structures as specified by the employer.

24.1.10 Warning signs. Warning signs shall be posted at access points to blasting areas.

24.1.11 Destruction of explosives. Explosives, blasting agents, and blasting supplies that have deteriorated or been damaged shall not be used. They and all excess explosives shall be destroyed or removed from the site in accordance with specific written manufacturer instructions acceptable to the employer.

24.1.12 **Empty explosive containers.** Empty boxes and combustible packing materials which have contained explosives shall be destroyed by burning method and procedure acceptable to the manufacturer and employer. In no case shall any person be allowed within 100 feet of the burning site once the material has been ignited, or until no visible flames or smoke have been detected for 1 hour.

24.1.13 **Fire.** Fires which involve explosives or where the fire is in imminent danger of contacting the explosives will not be fought. All employees shall be removed to a safe area, and the fire area shall be guarded to prevent intruders.

24.2 **RADIO AND ELECTROMAGNETIC RADIATION**

24.2.1 **Requirement.** Adequate precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, powerlines, and similar sources of electromagnetic radiation.

24.2.2 **Radio transmitters.** Where the safe clearance distances from radio frequency (RF) transmitter stations, as set forth in Institute of Makers of Explosives, publication 20 "Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use Of Electric Blasting Caps", cannot be observed, blasting shall be done with a totally nonelectric firing system. Electrical detonators shall not be stored or used within the Institute of Makers of Explosives (IME)-specified distances from a transmitter station.

24.2.3 **Mobile radio transmitters.** Unless deenergized and effectively locked, mobile or portable transmitters shall not be permitted within 100 feet of electric blasting caps or delays not in their original containers. Warning signs at least 36 by 42 inches in size, stating **BLASTING ZONE--TURN OFF 2-WAY RADIOS**, shall be posted on all public roads within 1,000 feet of blasting operations using electronic detonators.

24.3 **TRANSPORTATION OF EXPLOSIVES**

24.3.1 **Public highways.** The transportation of explosives by air, water, or on public highways shall comply with the provisions of Department of Transportation Regulations contained in 46 CFR Parts 146-149, "Water Carriers;" 49 CFR Parts 171-177 Subchapter C - "Hazardous Materials Transportation;" and 49 CFR Parts 390-397, "Motor Carriers."

24.3.2 **Vehicles.** Vehicles used to transport explosives shall conform to the following requirements:

- a. They shall be in good repair with all electrical wiring completely protected and securely fastened to prevent short circuits.
- b. They shall be thoroughly inspected prior to use to ensure that they are in safe condition and comply with the requirements of this paragraph.

- c. They shall have tight floors and any exposed spark-producing metal shall be covered with wood or other nonsparking material to prevent contact with containers of explosives.
- d. They shall not be loaded beyond rated capacity and the explosives shall be secured to prevent shifting or dislodgment.
- e. In open-body-type vehicles, the explosives shall be covered with a fire-resistant tarpaulin or transported in a class II magazine.
- f. Vehicles transporting explosives shall be marked with reflectorized signs on both sides, the front and rear, with the word **"EXPLOSIVES"** in red letters not less than 4 inches high on a white background or placarded in accordance with 49 CFR Part 172, Subpart F - "Placarding."
- g. They shall be equipped with two or more fire extinguishers having a rating of at least 2-A:40-B:C.

24.3.3 Vehicle operators. Operators of vehicles transporting explosives shall be licensed, physically fit, competent, able to read and understand instructions, and not addicted to the use of intoxicants or use narcotics. The operator shall be familiar with local, State, and Federal regulations, and the employer's safety requirements for transportation of explosives

24.3.4 Caps and detonators. Blasting caps and detonators shall not be transported with other explosives, unless the blasting caps or detonators are contained in a closed metal storage container having at least a 2-inch wood lining. Such containers shall be separated at least 2 feet from other explosives.

24.3.5 Flammable materials. Spark-producing tools, carbides, oil, matches, firearms, acids, storage batteries, oxidizing or corrosive compounds, or flammable materials shall not be transported with explosives.

24.3.6 Parking. Vehicles containing explosives shall not be left unattended nor parked in garages, shops, or other congested areas.

24.3.7 Fueling. Except in emergency, vehicles carrying explosives shall not be refueled.

24.3.8 Smoking restrictions. Persons employed in the transportation, handling, or use of explosives shall not smoke or carry on their persons or in the vehicle matches, lighters, firearms, ammunitions, or flame-producing devices of any description.

24.3.9 Riders. Only the authorized driver and his helper shall be permitted to ride on trucks transporting explosives or detonators.

24.4 TRANSPORTATION UNDERGROUND

24.4.1 **Requirement.** In addition to the requirements set forth in subsection 24.3, the provisions of this subsection shall apply to underground transportation of explosives.

24.4.2 **Hoists.** The hoist operator shall be notified before explosives or blasting agents are transported in a shaft conveyance. No persons shall be permitted to ride a hoist or shaft conveyance transporting explosives or blasting agents. Detonators and explosives shall not be transported at the same time.

24.4.3 **Powder cars and trucks.** Explosives and blasting agents shall be conveyed only in specifically built or equipped insulated powder cars or truck-mounted containers approved by the State entity having jurisdiction. The powder car shall be marked with reflectorized signs on both ends and sides, with the word **"EXPLOSIVES"** in letters at least 4 inches high, at all times that there are explosives in the car. The signs shall be covered or removed when there are no explosives present. If explosives and detonators are conveyed in the same vehicle, they shall be physically separated by at least 2 feet by wood-lined partitions, or by at least 6 inches of firmly fastened hardwood or equivalent. No explosives or blasting agents shall be transported on a locomotive, and at least two car lengths shall separate the locomotive from the powder car. Powder cars shall be pulled, not pushed, whenever possible.

24.4.4 **Man Haul.** Explosives or blasting agents shall not be transported on the man-haul trip. Only the operator, his helper, and the powderpersons shall be permitted on the powder-haul trip.

24.4.5 **Truck transportation.** Trucks transporting explosives underground shall meet other applicable provisions of these standards and have their electrical systems checked weekly to detect possible electrical hazards. A written record of such inspections shall be maintained. The installation of auxiliary lights on truck beds, which are powered by the truck's electrical system, are prohibited. Explosives shall not be stored in trucks.

24.4.6 **Transportation to face or loading area.** Only the quantity of explosives or blasting agents estimated necessary for the blast shall be taken to the face or loading area. Explosives or blasting agents shall not be taken to the loading area until the drilling has been completed and the holes are ready to be loaded. Surplus explosives and blasting agents shall be removed from the area prior to wiring up the blast.

24.4.7 **Makeups.** Unless a primer-makeup plan is submitted and approved by the employer, primers and delays shall be made up at the face or loading area.

24.5 STORAGE OF EXPLOSIVES

24.5.1 **Requirement.** Explosives and related materials shall be stored in approved magazines, and in accordance with the applicable provisions of the Bureau of Alcohol, Tobacco, and Firearms as set forth in 27 CFR Part 55, "Commerce in Explosives." Magazines shall be

bulletproof, rodent-resistant, weather-resistant, ventilated, and constructed to the standards of the Bureau of Alcohol, Tobacco, and Firearms, or the Institute of Makers of Explosives.

24.5.2 Magazine location. Explosive magazines shall be located in accordance with the State and local laws, and the proposed site shall be approved by the COR or office head prior to location or construction. The magazines shall be located in accordance with appendix N. Contractor and/or Government offices, shops, etc., are to be considered inhabited buildings when determining magazine locations.

24.5.3 Detonators. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents. Detonator magazines shall be located at least 100 feet, if unbarricaded, and 50 feet, if barricaded, from magazines containing other explosives or blasting agents.

24.5.4 Combustible materials. Smoking and open flame shall not be permitted within 100 feet of storage magazines. Vegetation and combustible material shall be removed for a distance of at least 25 feet from all magazines.

24.5.5 Security. Magazines shall be kept securely locked at all times except for inspection or the movement of explosives. An inventory shall be maintained of all storage and withdrawal of explosives. Any magazine storing explosives shall be inspected at least every 7 days to ensure that there has been no unauthorized entry or removal of explosives.

24.5.6 Posting. Areas around magazines shall be posted with 'EXPLOSIVES' signs, located so a bullet passing through the sign will not strike a magazine.

24.5.7 Storage. Explosives shall be stored only in their original containers. Containers of explosives shall be stored with the top side up as designated on the container. The oldest stock of explosives shall be used first.

24.5.8 Maintenance. Debris and combustible material shall be promptly removed from magazines. When magazine floors become stained with explosives, they shall be cleaned in accordance with the instructions of the manufacturer of the explosives.

24.5.9 Transfer in and out. Provision shall be made for the safe transfer of explosives in and out of magazines, including provision for ramps or walkways as necessary.

24.5.10 Storage underground. Permanent storage of explosives underground is prohibited and temporary storage shall comply with the following requirements:

- a. *Powder cars.* Temporary storage shall be restricted to limited supplies stored in specially designed powder cars located at least 1,000 feet from the face or blasting area. Transformers, storage of flammable materials, welding, open flame, smoking, and other ignition sources shall not be permitted within 100 feet of the powder car.

b. *Posting and lighting.* The storage area or siding shall be designated by a red light visible in all directions, and both ends of the powder car shall be posted with a luminous sign, stating **EXPLOSIVES - NO SMOKING, FLAME, OR WELDING WITHIN 100 FEET.**"

c. *Protection.* The powder car shall be located and/or barricaded to protect it from damage. Siding or car-passes when used for temporary storage shall be designed to protect the powder car from accidental entry by other cars, and to prevent accidental entry of the powder car to the main line. The protective devices installed shall be subject to approval of both the employer and the State entity having jurisdiction.

24.6 HANDLING OF EXPLOSIVES

24.6.1 **Requirement.** Explosives shall be handled carefully, and shall not be dropped, thrown, or slid. Detonators, primers, and other explosives shall be carried in separate containers when transported manually. When not in their original containers, they shall be placed in a suitable nonmetallic container for manual transportation.

24.6.2 **Removal from containers.** Explosives shall be removed from original containers only as needed for immediate use. Such containers shall be opened only by means of nonsparking tools or devices. Empty containers and packing shall be promptly burned in an approved location or disposed of in accordance with the manufacturer's recommendations.

24.7 LOADING EXPLOSIVES AND BLASTING AGENTS

24.7.1 **Planning.** Excavation shall be planned and scheduled in order that drilling and loading operations will not conflict. Loading shall not be permitted within 50 feet of drilling operations. No activity other than that which is required for loading holes shall be permitted within 50 feet of loaded holes or holes that have the explosives in place ready to load. Loading operations shall be under the supervision of the blaster.

24.7.2 **Drilling.** Drilling shall not be done in an area already blasted until remaining "bootlegs" (holes that do not detonate full depth) are examined for unexploded charges and the total area has been examined to make sure that there are no unexploded charges remaining. Drills, picks, or bars shall not be inserted into bootlegs even if examination fails to disclose explosives.

24.7.3 **Loading areas.** Boreholes shall be made ready and equipment and tools not used for loading shall be removed from the area before the explosives are delivered to the site. In major excavation operations, the loading areas shall be isolated by appropriate signs and/or temporary barricades to prohibit access by unauthorized persons.

24.7.4 **Boreholes.** Boreholes shall be large enough to permit loading of cartridges and explosives without forcing. Priming, loading, tamping, and firing shall be carried on as promptly as possible with a minimum of exposure to personnel.

24.7.5 Tamping. Tamping shall be done only with wooden or plastic tamping poles without exposed metal parts. Nonsparking metal connectors may be used on jointed poles. Cartridges shall be seated by even, steady pressure, and primers shall not be tamped.

24.7.6 Priming. The manufacturer's recommendations shall be followed in priming cartridges. Primers shall be made up only at the loading area, and in quantities limited to the number required for a single round of blasting (underground exception - subsec. 24.4).

24.7.7 Stemming. All blastholes in open work shall be stemmed with noncombustible material to the collar or to a point which will confine the charge.

24.7.8 Extraneous electricity. Electric conductors, electric equipment, and all sources of ignition shall be prohibited in or adjacent to the loading area. In tunnels and shafts, lights shall be removed 50 feet from the face prior to starting to load. Where stray currents are suspected, the area shall be thoroughly checked out with suitable instruments. If the elimination of stray currents is not possible, electric detonators, delays, and caps shall not be used or permitted in the area.

24.7.9 Shunts. The manufacturer's shunt shall not be removed from the cap leg wires until loading is completed and the cap is connected into the blasting circuit.

24.7.10 Springing holes. A borehole shall not be sprung when it is near a loaded hole. Dry cell batteries shall not be used for springing holes.

24.7.11 Blasting mats. Where blasting may expose persons or property to injury or damage from flying material, blasting mats shall be used to cover the charges. When used, care shall be used to protect the blasting circuits, and the circuits shall not be permitted to contact steel mats.

24.7.12 Loading and shooting. Loaded holes shall not be left unattended or unprotected. If possible, all holes loaded during a shift shall be fired on the same shift. In the event it is necessary to delay firing due to an emergency, the area shall be isolated and watchpersons posted to prevent entry to the area. In so far as possible, blasting operations above ground shall be conducted between sunup and sundown.

24.7.13 Pneumatic loading systems. Due to the hazards from static electricity and stray currents associated with pneumatically loading boreholes with blasting agents, the following precautions shall be taken:

- a. Only approved pneumatic loaders shall be used.
- b. The entire system, including placers, valves, and loading hose, shall be effectively grounded and bonded. In tunnels and shafts, the grounding shall be at the face, and piping and rails shall not be used to ground the system.

c. Checks shall be conducted, following installation of the ground, with an approved meter to ensure that the resistance is within safe limits.

d. Loading hoses shall be of an approved, nonsparking semiconductive material designed to maintain static electricity with safe limits.

24.7.14 Underground use of blasting agents. Prior to the use of blasting agents underground, the proposed method of loading and the loading equipment shall be inspected by a powder technician representing the explosive manufacturer or supplier. Written evidence of such inspection and approval of the systems shall be submitted.

24.8 WIRING OPERATIONS

24.8.1 Firing devices. Blasts using electric detonators shall be fired electrically with an electric blasting machine. Blasts shall not be fired by connection to any other electrical system. Blasts using nonelectric detonators shall be fired using a blasting machine or starting device prescribed by the detonator manufacturer. Cap and fuse firing shall not be used underground or in the excavation of shafts. Electric blasting caps shall not be used within 500 feet of energized high-voltage lines or facilities.

24.8.2 Wiring procedure. The manufacturer's shunt shall not be removed from the cap leg wires until the cap is connected to the leadlines or to another cap in preparation for the assembly of two or more caps into a single series. When two or more series of caps are to be fired as a series-parallel system, the caps in each series shall be the same in number (quantity, not delay periods) and each series shall be separately tested with an approved blasting galvanometer to: (a) ensure that the series is complete, and (b) ensure that each series has the same resistance and that the resistance is as close to the calculated resistance for the series. If the first reading indicates an incomplete circuit, the fault shall be located and corrected. If the second reading indicates a higher or lower resistance than calculated, the situation shall be corrected prior to final hookup and firing.

24.8.3 Electric caps and delays. All caps and delays in a shot shall be of the same manufacturer and the number in a circuit shall not exceed the capacity of the blasting machine or power source.

24.8.4 Galvanometer testing. The following tests shall be made with an approved blasting galvanometer during all wiring operations: (a) the circuit, including all caps, shall be tested before being connected to the firing line, and (b) the firing line shall be checked before being connected to the blasting machine or power source.

24.8.5 Firing lines. Firing lines shall be of sufficient current-carrying capacity, but not smaller than No. 14 gauge solid copper wire or equivalent. The firing line shall not be connected to the blasting machine or power source until the wiring has been completed and tested, and the blast area cleared. A power circuit used for firing electric blasting caps shall not be grounded.

24.8.6 Connecting and lead wires. Connecting and lead wires shall be insulated single solid wires of sufficient current-carrying capacity.

24.8.7 Power circuit. When using a power circuit for firing, the firing switch shall be locked in the "OFF" (open) position at all times, except when firing. It shall be designed so that the firing lines to the cap circuit are automatically short-circuited when the switch is in the "OFF" position. Keys to the firing switch shall be entrusted only to the blaster. In underground operations, there shall be a "lightning" gap of at least 5 feet in the firing circuit, located between the firing switch and the source of power. The gap shall be bridged with a flexible jumper cord just prior to firing the blast.

24.9 FIRING

24.9.1 Preparation. Prior to connecting the firing line to the power source, all personnel in the danger area shall be notified of the blast and removed to a safe area. Satisfactory arrangements shall be made for evacuating the danger area and ensuring that no one enters the area prior to the blast.

24.9.2 Responsibility. The blaster shall be in charge of the blasting machine or firing switch, and he/she shall connect the firing line to the firing device. All connections shall be made from the cap circuit back to the firing device, and the firing line shall remain shorted until connected to the firing device immediately prior to firing.

24.9.3 Blasting signal. The following blasting signal shall be sounded on a clearly audible whistle, horn, or siren before each surface or underground blast:

Blasting warning: a 1-minute series of long blasts 5 minutes prior to the blast signal

Blast signal: a series of short blasts 1-minute prior to the shot

All clear: a prolonged blast following inspection of the blast area

24.9.4 Posting blasting signals. Blasting signals shall be posted at all access points and, prior to each shot, competent flagpersons shall be posted at all access points to the danger area.

24.9.5 Disconnecting. Immediately following the blast, the firing line shall be disconnected from the firing power source or blasting machine, and shunted. Firing switches shall be locked open.

24.10 INSPECTION FOLLOWING A BLAST

24.10.1 All blasts. Prior to the all-clear signal, a thorough inspection shall be made by the blaster to determine if all charges have been fired. Wires shall be carefully checked and a search made for unexploded charges.

24.10.2 **Underground.** In addition to the previously listed requirements, the heading shall be checked and tested for adequate ventilation and safe concentrations of dusts, toxic vapors, and gases. Also, prior to permitting personnel in the heading, the face shall be scaled and made safe.

24.10.3 **All-clear signal.** The all-clear signal shall be sounded only after the inspection of the area has been satisfactorily completed.

24.11 MISFIRES

24.11.1 **Requirement.** If a misfire is suspected or found, all personnel except the blaster and employees necessary to handle the misfire shall be kept out of the danger area. No work shall be done in the danger area except that necessary to remove the hazard of the misfire. If a misfire occurs while using cap and fuse, all personnel shall remain at a safe distance from the charge for at least 1 hour.

24.11.2 **Refiring.** If broken wires or faulty connections are determined as the cause, repairs shall be made, the firing line reconnected, and an attempt made to fire the charge. Prior to removing explosives from a borehole, a new primer shall be placed in the hole and an attempt made to fire the charge. Any stemming shall be floated out with water.

24.11.3 **Removal of explosives.** This procedure shall be the last resort and performed only when refiring has failed or when refiring would present a hazard. Explosives may be removed by washing out with water or, if the misfire is under water, blown out with air.

24.11.4 **Work restrictions.** No drilling, digging, or picking shall be permitted until all missed holes have been detonated or the explosive removed, and the blaster has approved that work can proceed.

24.12 USE OF SAFETY FUSE

24.12.1 **Requirement.** Safety fuses shall be used only where sources of extraneous electricity make the use of electric caps dangerous. Use of damaged fuse or fuse with sharp kinks is forbidden.

24.12.2 **Capping.** Prior to capping a safety fuse, a short length shall be cut from the end to ensure a fresh-cut end in each blasting cap.

24.12.3 **Crimper.** Only cap crimpers of approved design shall be used for attaching blasting caps to safety fuse.

24.12.4 **Length of fuse.** The minimum length of safety fuse shall be as required by State law, but it shall not be less than 30 inches. Sufficient time shall be provided to permit the blaster to reach a place of safety.

24.12.5 **Multiple cap and fuse use.** At least two men shall be present when multiple cap fuse blasting is done by hand lighting methods. Not more than 12 fuses shall be lighted by each blaster when hand-lighting devices are used.

24.12.6 **Mudcapping.** Cap and fuse shall not be used for firing mudcap charges unless the charges are separated sufficiently to prevent one charge from dislodging other shots in the blast.

24.13 USE OF DETONATING CORD

24.13.1 **Care in use.** Only detonating cord consistent with the type and physical condition of the borehole, stemming, and the type of explosive shall be used. It shall be considered and handled in the same manner as other explosives.

24.13.2 **Installation.** The line of detonating cord extending out of a borehole or from a charge shall be cut from the supply spool before loading the remainder of the hole or placing additional charges. All runs shall be free of loops, sharp kinks, or angles that take the cord back toward the oncoming line of detonation.

24.13.3 **Connections.** Detonating cord connections shall be competent and positive in accordance with approved and recommended methods. Knot-type or other cord-to-cord connections shall be made only with detonating cord in which the explosive core is dry. Connections shall be inspected before firing.

24.13.4 **Use of delays.** When detonating cord millisecond-delay connectors or short-interval-delay electric blasting caps are used with detonating cord, the manufacturer's recommendations shall be followed.

24.13.5 **Connecting blasting caps.** When connecting blasting caps to detonating cord, the cap shall be taped or otherwise attached securely along the side or the end of the cord, with the end of the cap containing the explosive pointed in the direction in which the detonation is to proceed.

24.13.6 **Detonators.** Detonators for firing the trunkline shall not be brought to the loading area nor attached to the detonating cord until everything else is in readiness for the blast.

24.14 UNDERWATER BLASTING

24.14.1 **Supervision.** A competent blaster shall conduct all blasting operations, and no blast shall be fired without his/her approval.

24.14.2 **Loading tubes.** Loading tubes and casings of dissimilar metals shall not be used for electric or other stray current affected detonators or explosives. Loading shall be done through nonsparking loading tubes for these electrically affected devices when tubes are necessary.

24.14.3 **Detonators.** Only water-resistant blasting caps and detonating cord or other detonators and/or firing systems and methods for such service approved by the manufacturer shall be used in underwater blasting operations.

24.14.4 **Marking charges.** When more than one charge is placed under water, a float device shall be attached to an element of each charge in such a manner that it will be released by the firing. Misfires shall be handled as set forth in subsection 24.11.

24.14.5 **Blast warning.** In addition to the standard audible blast warning, blasting flags shall be displayed.

24.14.6 **Boats in area.** No blast shall be fired while any vessel underway is within 1,500 feet of the blasting area. Those onboard vessels moored or anchored within 1,500 feet shall be notified before the blast is fired.

24.14.7 **Swimming and diving.** No blast shall be fired when swimmers or divers are in the vicinity and exposed to injury from the blast.

Section 25

CONCRETE, MASONRY CONSTRUCTION, AND FORMWORK

25.1 PLANT AND EQUIPMENT

25.1.1 **General.** In addition to specific requirements in this section, the design, operation, and maintenance of all equipment and facilities and formwork used in concrete and masonry construction shall comply with requirements set forth in subsection 18.15 "Conveyors and Related Equipment," subsection 19.14, "Other Mechanized Construction Equipment Standards," all other applicable parts of these standards and specifications requirements, and the current edition of ANSI A10.9, "Construction and Demolition Operations-Concrete and Masonry Work." In the event of conflict between these standards, referenced standards and specifications, the more stringent will prevail.

25.1.2 **Batching and screening plants.** Concrete batching and screening plants, aggregate production plants, hoppers, bins, silos, and related equipment shall be designed and constructed with an adequate safety factor to eliminate danger of structural failure or collapse (refer to para. 19.14.11 for certification requirements). Batching plants, aggregate plants, and conveyor systems shall be designed and equipped with mechanical dust-control systems and water-spray systems or other acceptable means that control airborne dust concentrations within the safe hygienic limits prescribed in subsection 7.2. Effectiveness of the control system shall be confirmed in accordance with paragraph 7.1.3, or an equivalent means. Personnel shall not enter silos, storage bins, tunnels, shafts, or similar enclosed areas until the procedure conforms with requirements of subsection 7.8.

25.1.3 **Bulk storage bins.** Bulk storage bins, containers, and silos shall have conical or tapered bottoms with a mechanical or pneumatic means of starting the flow of material.

25.1.4 **Concrete mixers.** One cubic yard or larger loading skips shall have protective guardrails installed on each side of the skip and shall be equipped with a mechanical device to clear the skip of the material.

25.1.5 **Bull floats.** Handles on bull floats used where they can contact energized electrical conductors, shall be constructed of nonconductive material or insulated with a nonconductive sheath which will protect the operation from electrical shock.

25.1.6 **Powered concrete trowels.** Powered and rotating-type concrete troweling machines that are manually guided shall be equipped with a control switch or positive mechanical release device that automatically stops trowel rotation when the operator removes his/her hand from the equipment handle.

25.1.7 Concrete buggies. Handles of concrete buggies shall not extend beyond the wheels on either side of the buggy.

25.1.8 Concrete buckets. Concrete buckets equipped with hydraulic or pneumatically operated gates, shall have positive safety latches or similar safety devices installed to prevent premature or accidental dumping. The buckets shall be designed to prevent aggregate from accumulating on the top and sides of the bucket. Riding of concrete buckets is prohibited and no personnel shall be permitted under buckets suspended from cranes or cableways while they are being raised or lowered into position. To the extent practical, elevated concrete buckets shall not be routed over employees. Concrete buckets with manually operated gates shall be of the self-closing type. All buckets shall be maintained in structurally sound condition. Alterations that affect structural competency shall have approval of a professional engineer.

25.1.9 Transmix trucks. Transmix trucks and concrete pumping trucks, including operating procedures, will conform fully with requirements contained and referenced in this subsection, and subsection 19.7 "On-Highway-Type Equipment."

25.1.10 Personal protective equipment. Employees placing or finishing concrete shall wear applicable protective equipment specified by section 8, but never less than long sleeve shirts, long pants, rubber safety boots, gloves, hardhat, and eye glasses with side shields. Eyewash facilities shall be available at each placement or finishing operation.

25.1.11 Lockout/tagout. Equipment such as compressors, mixers, screens, and concrete pumps shall be locked out and tagged prior to making repairs.

25.2 CONCRETE CONVEYANCE SYSTEMS

25.2.1 General. "Concrete Conveyance Systems" are defined here as all mechanical devices utilized to move concrete from the receiving hopper of the system to the point of use; i.e., pumps, tremies, conveyor belts, flexible hoses, pipelines, and the structures and/or mobile equipment on which the system is installed. It does not include concrete buckets hoisted by cranes, cableways, or specialized hoisting systems, or transmix trucks used to convey concrete from the batch plant to the placement site. These types of mechanical devices are covered elsewhere in these standards.

25.2.2 Requirements. All concrete conveyance systems whether described herein or not shall be designed and certified as safe for intended use by the manufacturer or a professional engineer competent in the field. The contractor or owner/operator shall operate, maintain, inspect, and test the systems in accordance with the more restrictive requirements set forth in the manuals or instructions accompanying the system and/or machines, contained in applicable provisions of these standards, or in appendix U.

25.2.3 Crane boom mounted conveyor systems (app. R, fig. R-1):

a. Cranes:

1. *General.* Mobile cranes used to support conveyor systems shall be constructed, operated, inspected, maintained, and tested in accordance with the more stringent of these requirements or those contained and referenced in subsection 18.1, 18.2, 19.7, and appendix U.

2. *Performance inspections and tests.* Prior to onsite use and installation of conveyor system, the crane shall be performance inspected and tested in accordance with requirements contained and referenced in subsections 18.2, 19.7, and appendix U. Following installation of the conveyor system and special counterweights, the crane will be load tested in the manner prescribed in the manufacturer's or engineers' instructions. (Refer to app. R, fig. R-2.) Each time the conveyor system or special counterweights are removed from the crane and the crane is rigged for hoisting service, an additional full performance inspection and testing program conforming with appendix U will be conducted. Following reinstallation of the conveyor system, manufacturer's or engineers' load test will be performed prior to conveying concrete. Cranes brought to the worksite site with conveyor systems installed need only be inspected and load tested initially in accordance with the manufacturer's or engineers' procedures unless a complete performance inspection and testing is required by the COR or office head. The other applicable inspections and tests described above shall be performed whenever the conveyor systems are removed or reinstalled.

b. Specialized equipment:

1. **Safety tremie (app. R, fig. R-3).** The end discharge point of the conveyor system shall be equipped with a safety tremie and a tubular placing hose (elephant trunk). The tremie shall be equipped with a three-stage overload protective device. The safety device will be sequenced according to the manufacturer's or engineers' predetermined weight limit to first, shut down the conveyor and activate an operator's warning light; second, sound an audible alarm to warn the operator and other personnel of a continuing overloading condition; third, release the trunk from the tremie in a manner that allows the hose to swing free from the tremie while remaining suspended from a safety chain. The tremie safety devices shall be load tested in accordance with manufacturer or engineers' written procedures prior to each day's placement and when required by the COR or office head.

2. **Counterweights.** Only counterweights specified by the manufacturer or engineer shall be installed on the crane and then only in accordance with their written instructions.

3. **Control.** All conveyor and crane functions shall be controllable from the crane operator's station or an effective electronic communication system shall be provided

between the operator and all operating stations. Motorized equipment shall have emergency stopping provisions at all locations where personnel can contact moving parts.

c. **Operational requirements.** In addition to other operational requirements contained in these standards, appendix U, and manufacturer's or engineers' instructions, cranes with mounted conveyors shall be operated as follows:

1. Crane booms shall not be removed from manufacturer's or engineers' defined transport position until (1) all outriggers are fully extended and set on firm footings, (2) crane tires have been raised from any supporting surface, and (3) all counterweights are in place.
2. Cranes shall not be relocated or outriggers withdrawn unless the boom is in defined transport position.
3. Cranes shall not be used for lifting when conveyor package is installed.
4. Cranes with conveyor package installed shall be considered as traveling under loaded conditions when being moved on the construction site.
5. Unless spill prevention devices are installed along conveyor and at transfer points, employees shall not be allowed under the system.
6. Operator shall sound an audible alarm prior to starting conveyors.
7. Personnel shall not be permitted to ride on or work from conveyors.
8. Personnel engaged in operations that bring them in contact with the concrete shall wear personnel protective equipment and clothing required by section 8.
9. Movement of boom or placing hose in location outside the visible range of the operator shall be controlled by a signalperson having no other duties. Unless the signalperson is in a location where the operator, complete placing boom, and end hose can be seen simultaneously, a radio or telephone communication system shall be used.

25.2.4 **Concrete pumping systems.**

a. *General.* Concrete pumping systems consist of a concrete pump, pipeline (slickline) including short or long bends, couplings, intermediate and end hoses, and all supporting structures and equipment. Pipe accessories may include shutoff valves, direction change valves, articulating pipe connections, telescoping pipes, cleaning heads, trap baskets, and taper (transition) pieces. Concrete pumping systems may be of the stationary or mobile type or combination of both.

Design, installation, testing, and operation of all systems and supporting equipment shall conform with the more stringent of requirements contained or referenced in these standards or the manufacturer's or professional engineer's specifications. Only COR- or office head-acceptable concrete pumping systems shall be operated on construction sites.

b. Concrete pumping line (slickline, intermediate or end hoses, bends, couplings, transitions, etc.):

1. **General.** All materials, pipes, and accessories shall be certified by the manufacturer as safe for use in concrete pumping systems and within the calculated design pressures. Piping and accessories shall be removed from service whenever rupture safety factors (bursting pressure divided by maximum obtainable pump pressure) is less than two and preferably four. All hoses shall be approved type for concrete pumping operations and maximum anticipated operating pressures. Maximum approved operating pressures shall be affixed to the hose. Hoses shall be installed in accordance with manufacturers' approved methods and procedures. Safety lashings adequate to support a fully loaded hose shall be provided at all hose connections. Field repairs to hoses, pipes, and couplings are prohibited unless approved in writing by manufacturer.

2. **Couplings.** Couplings may be bolt, snap, toggle, or cup-tension type. **Cup-type coupling using flanges with same outer diameters as the pipe are prohibited** (app. R, fig. R-4). Snap- or toggle-type couplings shall be secured against accidental opening by safety pins or equivalent device. Couplings shall be clearly marked with shoulder diameter and pressure rating. They shall be rated at a pressure two times greater than the pumps maximum manufacturer rating. Adjustable couplings eye bolts shall have stops on adjustment threads to prevent overadjusting.

3. **Assembly.** All systems shall be assembled under the direct supervision of a competent person trained and experienced in the type of systems being installed. No concrete pumping system will be assembled or used on the construction site unless a manufacturer- acceptable piping wall thickness monitoring and replacement procedure (ultrasonic, weepholes, etc.) is in the possession of the system supervisor. All piping system components will be tested in accordance with the procedure prior to onsite use unless written evidence is provided that a satisfactory testing procedure is in place and functioning.

Adjoining pipe terminations shall be compatible with each other and the coupling. Mating pipe terminations shall be the same diameter as marked on the coupling. Flange shoulder constructed by welding, screwing, or otherwise attaching an external ring to the pipe or grooved-type flanges the same diameter as the pipe are prohibited.

All piping shall be securely braced and anchored in a manner that minimizes movement and ensures restraint of line parts if failure occurs. Piping shall not be attached to or supported from structural members or formwork or installed on

equipment that may impose loadings beyond design criteria without engineer or manufacturer approval.

4. **Cleanout operations.** All concrete placing pipelines may be cleaned utilizing one or more of the following procedures:

(a) **Suction (preferred procedure refer to app. R, fig. R-5).** Insert a soft rubber sponge ball into end hose. Use the pump to suck the concrete and ball back into the hopper.

(b) **Water pressure procedure (preferred procedure refer to app. R, fig. R-6.)** A specialized pipe cleaning head is attached to pump side of the pipeline. A paper plug made from wet double-folded close-furled empty cement bags is placed in the head, followed by a sponge rubber ball, arranged so the bags are in contact with the concrete. Water pressure is then applied to the ball through a connection in the head.

If the concrete and water are to be wasted at the discharge end, the bends and end hoses can be left in place. If the water is to be retained in the pipe and returned to the pump, the elbows and end hoses are removed and a catch basket is attached to the end of the pipe. (Refer to app. R, fig. R-6.) The catch basket is so arranged that the plug and ball remain in the end of the pipe and seal in the water. The water can then be forced back through the pipe to the pump by air of water pressure.

(c) **Compressed air procedure.** This procedure for cleaning pipelines is most hazardous and requires exacting methods and specialized equipment for ensuring safety of personnel. It shall only be used with prior approval of the COR or office head and in accordance with the following or equivalent safe methods:

(1) Blowing out is performed under supervision of a trained employee.

(2) All nonessential personnel are moved to a safe location.

(3) The pipeline inlet end is equipped with a blowing hood complete with ball and plug as shown in figure R-7.

(4) Bends and end hose are removed from pipeline discharge end. A catch basket (app. R, fig. R-7) of correct size to allow the concrete to flow freely, but prevents the plug and ball from exiting the pipeline and breaking the hermetical seal that keeps the compressed air in the line, is attached to the pipeline discharge end.

(5) Air pressure in the pipe is slowly built up until the air gage indicates movement of concrete, but never beyond 150 pounds per square inch. The air pressure is constantly monitored until the plug enters the catch basket.

(6) The air pressure is then relieved to zero gage pressure through an air relief cock in the blowing head, prior to working on the line or removing the catch basket and plug.

Caution: Extreme care must be exercised when cleaning vertical pipes with compressed air. High pressure air pockets that cannot be relieved through the relief cock can be created in the line where the concrete column separates. Column separation occurs when the bottom of the line is disconnected prior to attaching the blowing head.

c. Placing booms.

1. **General.** Placing booms and all supporting structures or equipment shall be designed and certified for the intended use by the manufacturer or a design engineer competent in the field. Design considerations for placement booms and supporting structures and equipment shall meet or exceed applicable ANSI requirements for mobile or stationary boom type cranes. (Refer to sec. 18.) Delivery piping, intermediate or end hoses, couplings and accessories supported by or used in conjunction with placing booms shall conform with subparagraph 23.2.4.b.(2). Each section of rigid pipeline or hose shall be anchored to the boom, so in the event of coupling or adapter failure no section can fall from the boom. Metal pipe swivels are the preferred method for accommodating boom folding actions.

All hydraulic cylinders shall be equipped with hydraulic pressure relief valves that automatically prevent boom or cylinder damage. Placing booms shall not be used for hoisting any loads except system piping, accessories and the concrete being conveyed.

2. *Mountings.* Design and operation of trailers and trucks on which placing booms are mounted (app. R, fig. R-8) shall conform with requirements of section 19 and DOT regulations. They shall be inspected and brake tested in accordance with section 19. Boom stationary-type mountings (app. R, fig. R-9) shall be designed by the manufacturer or professional engineer competent in the field. Weight of boom, attachments, and accessories shall be displayed in a readily visible place on the boom. All outriggers, jacks, or other stabilizing features required by the manufacturer or engineer shall be clearly stated on the boom or in the operating instructions. Outriggers will be visibly marked with maximum load imposed on supporting surface. Outrigger controls shall be located so the operator can continuously observe the outrigger whenever it is being extended or retracted.

3. *Controls and gauges.* Permanently installed controls shall be mounted so the operator cannot be struck by the boom or other moving parts, and has a clear view of receiving hopper. Control panels and operator platforms shall be adequately lighted during night operations. (Refer to sec. 7 of these standards.) Access to elevated control stations shall be in accordance with the three point method described in section 19. All operating platforms shall be protected by adequate guardrails meeting requirements of section 19.

Controls shall be marked by symbols or wordings that clearly indicate their functions and, where possible, the direction of control movement should correspond with direction of motion being controlled. The controls shall be arranged so that no combination can cause motions not intended by the operator. All controls shall be deadman type.

Combination stationary and remote control systems for booms shall be provided with positive means for ensuring the unit can only be operated from one location at a time. All control panels (stationary or remote) shall have means for locking them in the "off" position when unattended.

Gauges for detecting critical temperatures and pressures not under direct observation of the operator shall be equipped with automatic shut off or control devices that limit temperatures or pressures to within predetermined safe limits.

An emergency, all function, stop button shall be provided on all control panels. The button shall be readily identifiable by size and color and accessible from the normal working surface.

Radio remote controls shall be of the FCC-type (Federal Communication Commission) accepted for two-way communication and have shielding, filtering, and discrete coding provisions that protect against accidental stimulation of the receiver.

4. Performance inspection and testing.

(a) **Stationary mounting.** Following major repairs or alterations to critical structural members, or when directed by the COR or office head, stationary-type placing booms shall be performance inspected and load tested in accordance with the manufacturers and/or engineers' instructions.

Further, placement booms mounted on stationary-type supporting systems shall be considered as undergoing major alteration when first placed on each new supporting structure or at a new location and shall be performance and load tested prior to use at the new location. Movement of the boom between tested structures or locations does not require additional load test unless required by the COR or office head. However, relocated booms shall always be given a cursory operational test before conveying concrete. This test shall include (1)

full extension of all boom sections to a horizontal position with end hose attached, (2) rotating the boom through 360 degrees or maximum degrees of operation, (3) raising extended boom to vertical position and rotating through 360 degrees or maximum degrees possible, and (4) testing of relief valve settings by folding boom sections against each other.

(b) **Mobile mountings.** Placement booms mounted on truck chassis or trailers shall be performance inspected and load tested following repair or alterations to critical components and when directed by the COR or office head. Further, they shall undergo the more stringent of the cursory test described under subparagraph "(1)" above or those described in the manufacturer or engineer's instructions whenever relocated to any load tested location. The COR or office head may exempt supplier owned/ operated truck- or trailer-mounted units from load tests when: (1) the equipment is used onsite sporadically or for short intervals, (2) no critical-type defects are found after visual inspection and cursory test specified in subparagraph "1" above are conducted, (3) the owner/operator has written confirmation that the boom and supporting equipment have satisfactorily undergone a performance inspection and load test following the repairs or alterations.

(c) **Performance inspection and load test procedures.** Performance inspections shall be made of all critical components to determine if they meet manufacturer or engineer's minimum recommended levels specified in operating and/or inspection manuals or instructions. If no such information is available, it shall be developed by the manufacturer or engineer and used for making the inspection. Load test shall be made with test weights spaced along the boom as specified by the manufacturer or engineer. Load test data supplied by the manufacturer or engineer shall be considered unacceptable unless it adequately tests all critical structural components and tipping moments to 100 percent of manufacturer's maximum rated conditions, and load-limiting devices are tested to activating limits.

d. *Concrete pumps.*

1. **General.** Concrete pumps shall be designed and certified for intended use and pressures by a manufacturer or professional engineer. Truck chassis, trailers, skids, or railcars on which pumps are mounted shall conform with applicable requirements of sections 19, 23, and 25 of these standards. Skid-mounted pumps shall have sufficient eyes for attaching slings or special hoisting devices. A permanent notice stating overall weight of pump and supporting structures shall be affixed to the pump.

Pumps shall be supported, anchored, and stabilized in accordance with manufacturers or engineers' requirements. All docks, outriggers, or axle locks specified by the manufacturer or engineer will accompany the unit and be placed in recommended operating position prior to starting pumping operations.

2. **Controls and gauges.** Permanently installed controls shall be mounted so the operator can observe all critical pump components. Control panels and operating platforms shall be adequately lighted during night operation. Controls shall be marked by symbols or wording that clearly indicates their functions. Combination stationary and remote control panels for pumps shall be provided with positive means for ensuring the unit can only be operated from one location at a time.

All control panels shall have means for locking them in the "off" position when unattended. Gauges for detecting critical temperatures and pressures, not under direct observation of the operator, shall be equipped with automatic shutoff or control devices that limit temperature and pressure to within predetermined safe limits. An emergency all function stop button shall be provided on all control panels. The button shall be readily identifiable by size and color and accessible from normal work surfaces. Radio remote controls shall be of the FCC-type accepted for two-way communication and have shielding, filtering, and discrete coding provisions that protect against accidental stimulation of the receiver.

3. **Specific requirements.** Dangerous moving parts shall be guarded. The receiving hopper shall be so positioned that concrete can readily flow from transmix trucks or other concrete conveyance equipment discharge chute into the hopper. A hinged grill shall be provided to prevent access to dangerous moving parts. The grill shall be securely mounted on the hopper with an interlocking arrangement that prevents access until feed, agitator, and valve mechanisms are rendered inoperative. Grill parallel bar spacings shall not exceed 2-3/4 inches, and shall be capable of supporting a 250-pound load.

Inlet and outlet valves and chambers shall be so constructed that personnel access is restricted until all energy sources are locked out and stored energy dissipated.

e. **General operating requirements.**

1. Only trained competent personnel shall install or operate concrete pumping systems and equipment.
2. Personnel shall not work on any piping system or supporting structures unless all inline pressures have been relieved by running pump in reverse and/or opening air or water relief valves.
3. Pumps should be so located that backing of trucks is eliminated. If backing is necessary, it shall be under the direction of a signalperson standing to the side of the truck.
4. Trucks on which pumps and placing booms are installed that use truck engine power to operate the equipment shall conform fully with paragraph 19.2.3 and all other applicable provisions of section 19 of these standards.

5. End hoses shall not exceed lengths specified by manufacturer or engineer. End hoses shall not be dragged laterally by placing booms. Manual relocation of the hose will be accomplished using pulling slings.
6. The operations or transportation of placing booms in close proximity to high-voltage powerlines shall conform with paragraphs 12.9.2 and 12.9.3 of these standards.
7. Movement of placing booms and end hose in location outside the visible range of the operator shall be controlled by a signalperson having no other duties. Unless the signalperson is in a location where the boom operator and complete placing boom and end hose can be seen simultaneously, a radio or telephone communication system shall be used.
8. Placing booms shall not be externally braced or laid on any supporting structure during pumping operations unless approved by the manufacturer or design engineer.
9. All outriggers, jacks, or other stabilizing features required by the manufacturer or engineer shall accompany the boom or pump and be in recommended operating position prior to conveying concrete.
10. Mobile-mounted placing booms shall not be relocated or outriggers withdrawn unless the boom is in defined transport position.

25.3 REINFORCING STEEL

25.3.1 **Lateral supports.** Reinforcing steel for walls, piers, columns, and similar structures shall be laterally supported to resist overturning. The lateral supports for reinforcing steel shall be capable of withstanding the forces that will be applied to them during construction.

25.3.2 **Rigging.** Bundles of reinforcing steel moved by crane or cableway shall be securely tied together to prevent slipping, and steel over 20 feet in length shall be handled by two-part slings.

25.3.3 **Impalement.** Exposed rebar onto or into which employees could fall shall be covered to eliminate the hazard of impalement. Plastic cap coverings shall not be used for impalement protection, but may be used to cover the ends of horizontal rebar. Wood troughs or other substantial material shall be used to cover vertically protruding rebar.

25.3.4 **Safety belts.** Employees working more than 6 feet above any adjacent working surfaces, placing and tying reinforcing steel in walls, piers, columns, etc., shall wear safety belts, or equivalent devices, as set forth in subsection 8.8.

25.3.5 **Walkways.** Reinforcing mats used as walkways shall be provided with planking to afford safe footing.

25.3.6 Prohibited uses. Reinforcing steel shall not be used as guy attachments at deadmen or other anchorage points and shall not be used for scaffolding hooks, stirrups, or as a load-bearing member of any lifting device.

25.3.7 Wire mesh mats. Wire mesh reinforcing mats shall be secured at each end to prevent recoiling action. Unrolled wire mesh shall be secured on each side of a proposed cut before cutting the mesh.

25.3.8 Post-tensioning operations. No employee, except those essential to post-tensioning operations, shall be permitted to be behind the jack during tensioning operations. Signs and barricades shall be erected to limit employee access to the post-tensioning area during tensioning operations.

25.4 SURFACE PREPARATION

25.4.1 Green cutting or abrasive blasting. Employees engaged in green cutting shall wear eye and face protection as required by subsection 8.3. Employees engaged in wet or dry abrasive blasting using silica sand shall wear an approved abrasive blasting air-line respirator required by paragraph 8.4.6, heavy-duty footwear specified in paragraph 8.6.6, and hardhat specified in subsection 8.2.

25.5 FORMWORK AND FALSEWORK

25.5.1 Design and erection. In addition to the specific requirements set forth in this section, the design and erection of formwork or falsework shall be in accordance with specifications, pertinent provisions of the latest edition of ACI 347, "Recommended Practice for Concrete Formwork," and ACI 318, "Building Code Requirements for Reinforced Concrete," and current edition of ANSI A10.9, "Construction and Demolition Operations-Concrete and Masonry Work."

25.5.2 Safety factor. Formwork, falsework, structural shoring, and bracing shall be designed, erected, braced, and maintained so that it will safely support all vertical and lateral loads that might be applied until such loads can be supported by the structure. The minimum safety factors as specified in ANSI A10.9 shall be incorporated in the design and erection of all framework, shoring, falsework, and formwork accessories.

25.5.3 Construction loads. Imposition of any construction loads on the partially completed structures shall not be permitted unless such loading has been considered in the design, and shown on the formwork design drawings and/or specifications.

25.5.4 Drawings and plans. Formwork and shoring shall be designed by a professional engineer or a qualified form designer familiar with the design requirements referenced in paragraphs 25.5.1 and 25.5.2. Drawings or plans showing the jack layout, formwork, shoring working decks, and scaffolding shall be available at the jobsite.

25.5.5 Form anchors. Form anchors which support forms and scaffolding shall be designed with a minimum safety factor of three. No load shall be imposed on form anchors or concrete anchorages until the concrete has been allowed to set the minimum periods of time set forth in paragraph 25.11.4. Form sections supported by form anchors shall not exceed 50 feet in length and shall be installed in such manner that no impact loading, resulting from a form or anchorage failure, can be transferred to an adjacent section.

25.5.6 Housekeeping. In all areas in which persons are required to work or pass, stripped forms and shoring shall be removed and stockpiled promptly after stripping. Protruding nails, wire ties, and other accessories not required for subsequent work shall be pulled, cut, or other measures taken to remove the hazard.

25.6 VERTICAL SHORING

25.6.1 Additional loading. Temporary storage of reinforcing rods, materials, or equipment on top of formwork is prohibited unless these temporary structures have been designed or strengthened to support the additional loading. Eccentric loads on shore heads and similar members shall be prohibited unless these members are designed for such loadings.

25.6.2 Sills. Sills used in shoring shall be sound, rigid, and capable of carrying the maximum intended load.

25.6.3 Shoring equipment. All shoring equipment shall be inspected prior to erection to determine that it is as specified in the shoring layout. Equipment found to be damaged shall not be used for shoring.

25.6.4 Inspection. Erected shoring equipment shall be inspected immediately prior to, during, and immediately after the placement of concrete, to determine that the shoring equipment meets the requirements specified on the form work drawings. Any shoring equipment found to be damaged or weakened shall be immediately reinforced or reshored.

25.6.5 Reshoring. Reshoring shall be provided when necessary to safely support slabs and beams after stripping or where such structures are subjected to superimposed loads.

25.6.6 Removal of shoring. Removal of shoring equipment shall not be undertaken until the concrete has reached the minimum strength called for in the formwork and shoring design and the placement has been inspected and approved by a qualified engineer or supervisor. Removal shall be planned so that shoring equipment still in place is not overloaded.

25.7 TUBULAR WELDED FRAME SHORING

25.7.1 Safe loading. Metal tubular frames used for shoring shall not be loaded beyond the safe working load recommended by the manufacturer. Metal tubular frame shoring shall be designed with a minimum safety factor of 2.5.

25.7.2 **Condition.** Locking devices on frames and braces shall be in good working order; coupling pins shall align the frame or panel legs; pivoted cross braces shall have their center pivot in place; and all components shall be in good serviceable condition. Faulty or damaged parts and components shall be promptly repaired or replaced.

25.7.3 **Inspection.** Following erection, a thorough inspection shall be made to ensure that: (1) spacing between towers and cross brace spacing does not exceed that shown on the layout, and that all locking devices are in the closed position, (2) the devices for attaching the external lateral stability bracing are securely fastened to the legs of the shoring frames, and (3) baseplates, shoreheads, extension devices, or adjustment screws are in firm contact with the footing sill and the form.

25.8 TUBE AND COUPLER SHORING

25.8.1. **Design.** Tube and coupler shoring shall be designed for the maximum intended loading with a minimum safety factor of 2.5.

25.8.2 **Couplers.** Couplers (clamps) shall be of a structural-type metal such as drop-forged steel, malleable iron, or structural grade aluminum. Gray cast iron shall not be used. Couplers that are deformed, broken, or have defective or missing threads or bolts shall not be used.

25.8.3 **Inspection.** Following erection, a thorough inspection shall be made to ensure that:

- a. The shoring has been erected as shown on the layout drawings.
- b. The spacing between posts does not exceed that shown on the layout.
- c. All interlocking tubular members and couplings are properly installed and tightened.
- d. All baseplates, shore heads, extension devices, or adjustment screws are in firm contact with the footing sill and the form material, and snug against the legs of the frames.

25.9 SINGLE-POST SHORES

25.9.1 **Design.** Single-post shoring layouts shall provide for the maximum intended loading with a minimum safety factor of three. When single-post shores are to be used in more than one tier, they shall be designed and inspected by a registered structural engineer.

25.9.2 **Bracing.** Single-post shores shall be horizontally braced in both the longitudinal and transverse directions, and shall also be braced diagonally. The bracing shall be installed as the shores are being erected.

25.9.3 **Inspection.** Single-post shores and adjusting devices shall be inspected before use. Fabricated shores and adjusting devices shall not be used if heavily rusted, bent, dented,

rewelded, damaged, or defective in any manner. Timber shores and timber components of fabricated shores shall not be used if split, knotted, broken, or otherwise structurally defective.

25.9.4 Baseplates and shore heads. Baseplates and shore heads of single-post shores shall be in firm contact with the footing sill and the form materials.

25.9.5 Angled formwork. When formwork is at an angle or sloping, or when the shored surface is sloping, the shoring shall be specially designed for such loading.

25.9.6 Adjustment. Adjustment of single-post shores shall not be made after concrete is in place.

25.10 VERTICAL SLIP-FORMS

25.10.1 Design and supervision. All vertical slip-forms shall be designed by a registered professional engineer experienced in slip-form design. Drawings prepared by the engineer showing the jack layout, anchorages, formwork, scaffolding, etc., together with installation, jacking, and leveling instructions shall be available at the jobsite and followed. The installation movement and leveling of the forms shall be carried out under the immediate supervision of a person or persons experienced in slip-form operations.

25.10.2 Jack supports. The steel rods or pipe on which the jacks climb or by which forms are lifted shall be designed for that purpose. Such supports shall be encased in concrete or otherwise anchored. Supports anchored or secured by form anchors shall utilize at least two independent form anchors separated a minimum of 5 feet vertically.

25.10.3 Vertical loading. Jacks and vertical supports shall be positioned so that the vertical loads are distributed equally and do not exceed the capacity of the jacks.

25.10.4 Line and plumb. During jacking operations, the form structure shall be maintained in line and plumb.

25.10.5 Lifting. Lifting shall proceed steadily and evenly and shall not exceed the predetermined safe rate of lift.

25.10.6 Bracing. Lateral and diagonal bracing of the forms shall be provided to prevent excessive distortion of the structure during the jacking operation.

25.10.7 Holding devices. The jacks or other lifting devices shall be provided with mechanical dogs and other automatic holding devices to provide protection in event of failure of the power supply or the lifting mechanism.

25.10.8 Scaffolding and platforms. Vertical lift forms shall be provided with scaffolding or work platforms, installed in compliance with subsection 25.13, completely encircling the area of placement.

25.10.9 **Supervision.** Vertical slip form operations shall be under the supervision of an experienced supervisor, who shall be present on the deck during slipping.

25.11 **RELEASING AND MOVING FORMS**

25.11.1 **Lifting.** Forms shall be securely attached to wire rope slings, having a minimum safety factor of eight, when raised or moved by crane, cableway, A-frame, or similar mechanical lifting device. Panels and form sections shall be equipped with hoisting brackets for attachment of slings. Loose tools and materials shall be removed prior to moving the forms. Taglines for controlling forms shall be used whenever necessary to protect personnel or structures.

25.11.2 **Riding forms.** Employees shall not be permitted to ride on forms or form scaffolding being raised or moved, with the exception of vertical slip-forms.

25.11.3 **Releasing.** Vertical and overhead forms shall not be released until adequately braced or secured. Employees at lower levels exposed to falling materials shall be removed to a safe area prior to release and moving of forms.

25.11.4 **Form removal.** Forms shall not be removed until the concrete has sufficiently set to allow the safe removal of the forms, shoring, and bracing. When not specifically stated in the contract specifications or shown on the form drawings, under normal conditions form supports shall remain in place for at least the following periods of time following concrete placement:

Arch centers	14 days
Centering under beams	
(clear span less than or equal to 20 feet)	14 days
(clear span over 20 feet)	21 days
Floor slabs	7 days
(less than or equal to 20 feet between structural supports)	7 days
(over 20 feet between structural support)	10 days
Walls	12-24 hours
Columns	12-24 hours
Sides of beams or girders	12-24 hours

(Whenever forms for walls, columns, or the side of beams and girders also support formwork for slabs or beam soffits, the removal time for the slab or beam soffits shall govern.)

The periods indicated represent the cumulative number of hours or days, not necessarily consecutive, during which the temperature of the concrete is above 50 EF.

25.25.12 PRECAST CONCRETE

25.12.1 **Requirement.** Precast concrete walls, structural framing, or tilt-up wall panels shall be laterally supported to resist overturning forces until permanent connections are completed.

25.12.2 **Lateral supports.** The lateral supports for precast concrete walls, structural framing, or tilt-up wall panels shall be capable of withstanding a load of 15 pounds per square foot applied to these units.

25.12.3 **Suspended loads.** Employees shall not be permitted under precast concrete members being lifted or tilted into position.

25.12.4 **Lifting inserts.** The lifting inserts for tilt-up precast concrete members shall be capable of supporting at least two times the maximum intended load applied or transmitted to them. Other types of lifting inserts for precast concrete members shall be capable of supporting at least four times the maximum intended load applied or transmitted to them.

25.13 LIFT-SLAB

25.13.1 **Lift-slab operations.** Lift-slab operations shall be designed and planned by a registered professional engineer who has experience in lift-slab construction. Such plans shall include detailed instructions and sketches indicating the prescribed method of erection, and for ensuring lateral stability of the building/structure during construction.

25.13.2. **Jacks/lifting units.** Jacks/lifting units shall be marked to indicate their rated capacity as established by the manufacturer. They shall be designed with a minimum safety factor of 2.5. Jacks/lifting units shall not be loaded beyond their rated capacity.

a. Jacking equipment includes any load bearing component which is used to carry out the lifting operation, such as threaded rods, lifting attachments, lifting nuts, hook-up collars, t-caps shearheads, columns, and footings.

b. Jacks/lifting units shall be designed and installed so that they will neither lift nor continue to lift when they are loaded in excess of their rated capacity.

c. Jacks/lifting units shall have a safety device installed which will cause the jacks to support the load in any position in the event any jack malfunctions or loses its lifting ability.

25.13.3 **Jacking operations.** Jacking operations shall be synchronized in such a manner to ensure that the slab is maintained level at all support points to within a 1/2 inch tolerance at all times.

- a. If leveling is automatically controlled, a device shall be installed that will stop the operation when the tolerance is exceeded or when there is a malfunction in the jacking system.
- b. If leveling is maintained by manual controls, such controls shall be located in a central location, and attended by an experienced competent person while lifting is in progress. The maximum number of manually controlled jacks/lifting units on one slab shall be limited to a number that will permit the operator to maintain the slab level, with the maximum number not to exceed 14.
- c. Under no circumstances, shall any employee who is not essential to the jacking operation be permitted immediately beneath a slab while it is being lifted. Only employees essential to the jacking operation shall be permitted in the building/structure while any jacking operation is taking place.
- d. When making temporary connections to support slabs, wedges shall be secured by tack welding, or an equivalent method to prevent them from falling out of position. Lifting rods may not be released until the wedges at the column have been secured.
- e. All welding on temporary and permanent connections shall be performed by a certified welder, familiar with the welding requirements specified in the plans and specifications for the lift-slab operation. Load transfer from jack/lifting units to building columns shall not be executed until the welds on the column shear plates are cooled to air temperature.
- f. Jacks/lifting units shall be positively secured to building columns so that they do not become dislodged or dislocated. Equipment shall be designed and installed so that the lifting rods cannot slip out of position.

25.14 MASONRY CONSTRUCTION

25.14.1 Requirements. A limited access zone shall be established whenever a masonry wall is being erected. The limited access zone shall be equal to the height of the wall to be constructed, plus 4 feet, and shall run the length of the wall. The limited access zone shall be established prior to the start of construction, and shall be located on the side of the wall which will be unscaffolded. Employees not directly involved in the construction of the wall will not be permitted in the limited access zone. The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse. The supports shall be capable of a load of a minimum of 15 pounds per square inch. For walls over 8 feet in height the supports shall remain in place until permanent supporting elements of the structure are in place.

25.14.2 Equipment. Masonry saws shall be guarded with (a) a semicircular enclosure over-blade, and (b) a slotted horizontal hinged bar mounted underneath the guard enclosure to retain fragments of shattered blades. Saws shall be equipped with dust-control systems and/or

provisions for wet sawing that control airborne dust concentrations within the safe hygienic limits prescribed in subsection 7.2.

25.15 SCAFFOLDING

25.15.1 **Requirements.** Employees working on forms, walls, floors exposed to falls over 6 feet shall be provided with scaffolding and guardrails or safety nets, or wear and be required to use safety belts and lanyards meeting requirements of subsection 8.8.

25.15.2 **Design and installation.** Form and masonry scaffolding shall be designed for a minimum loading of 50 pounds per square foot. Additionally, such scaffolding shall be designed, installed, inspected, and maintained in accordance with applicable provisions of section 13.

Section 26

STEEL ERECTION

26.1 GENERAL

26.1.1 **Requirement.** Storage, handling, and erecting of steel structures, buildings, or structural components or members shall conform to the applicable requirements of these standards and the current edition of ANSI A10.13, "Safety Requirements for Steel Erection." In the event of conflicts between the provisions of these or referenced standards or specifications requirements, the more stringent shall prevail.

26.1.2 **Fall protection.** A fall protection program shall be developed prior to starting steel erection. The program shall include all phases of the steel erection and shall eliminate as far as possible employee exposure to falls.

- a. The program shall detail the steps to be taken to provide protection for employees exposed to potential falls.
- b. A training program shall be provided for all employees involved to enable each employee to recognize the fall hazards involved and the procedures to be followed to minimize the hazard.

26.2 PERMANENT FLOORING

26.2.1 **Installation.** Permanent floors shall be installed as the erection of structural members progresses and there shall not be more than eight stories between the erection floor and the uppermost permanently secured floor.

26.2.2 **Bolting and welding.** There shall not be more than 4 floors or 48 feet of unfinished bolting or welding above the structure foundation or the uppermost permanently secured floor.

26.3 TEMPORARY FLOORING

26.3.1 **Planking.** The derrick or erection floor shall be solidly planked or decked over its entire surface except for access openings. Planking, or decking, shall be of sufficient thickness and strength to support the working load. In no event shall planking be less than 2 inches thick, full dimension undressed, and it shall be laid flush and secured to prevent movement. All temporary flooring shall be secured to prevent displacement by wind.

26.3.2 **Skeleton steel erection.** Where skeleton steel erection is being done, a tightly planked and substantial floor shall be maintained within two stories or 30 feet, whichever is less, below

and directly under that portion of each tier of beams on which any work is being performed; except when gathering and stacking temporary floor planks on a lower floor in preparation for transferring such planks for use on an upper floor. When installation of such a floor is not practicable, safety nets shall be installed.

26.3.3 Safety nets. On bridges, buildings, or structures not adaptable to temporary floors, and where scaffolds are not used, safety nets shall be installed when the potential fall distance exceeds 25 feet. Safety nets shall be fabricated, installed, tested, and maintained as set forth in subsection 8.10.

26.3.4 Temporary planking removal. Temporary planking shall be removed successively, working toward the last panel of temporary floor, so that work is done from the planked floor. Employees removing planks from the last panel shall be protected by safety belts with safety lines attached to a catenary line or other substantial anchorage.

26.4 OTHER FLOORING

26.4.1 Double-wood floors. In erection of buildings having double-wood floor construction, the rough flooring shall be completed as the construction progresses, including the tier below the one on which floor joists are being installed.

26.4.2 Single-wood floor. For single-wood floors or other flooring systems, the floor immediately below the story where the floor joists are being installed shall be kept planked or decked over.

26.5 GUARDRAILS. Temporary or permanent floor perimeters over 4 feet above adjoining surfaces shall be enclosed on all sides with a standard guardrail as set forth in subsection 13.3.

26.6 STRUCTURAL STEEL ERECTION

26.6.1 Solid-web structural members. In placing solid-web structural members, the hoisting line shall not be released until the member is secured with not less than two bolts or 10 percent of the bolts, whichever is greater, at each connection. The bolts shall be drawn up wrench tight.

26.6.2 Open-web joists. Open-web steel joists shall not be placed on any structural steel framework until such framework is permanently bolted, riveted, or welded.

26.6.3 Bar joists. In steel framing, where bar joists are used and the columns are not framed in at least two directions with structural steel members, a bar joist shall be field bolted at the columns to provide lateral stability.

26.6.4 Long-span joists. Where long-span joists or trusses 40 feet or longer are used, a center row of bolted bridging shall be installed prior to slacking of the hoisting line in order to provide lateral stability.

26.6.5 Securing structural members. Each structural steel member shall be securely bolted or fastened into position before the loadline is released. When setting steel trusses, they shall be temporarily cross braced until permanent bracing is installed.

26.6.6 Taglines. A tagline or guide rope shall be used on all hoisted loads where personnel are exposed to the swing of the load.

26.6.7 Temporary support. When columns are being set on base plates or shims, the anchor bolts shall be drawn down tight or they shall be guyed and supported to prevent collapse, before lifting falls are unhitched.

26.6.8 Connectors. Whenever possible "Connectors" shall straddle the beam instead of walking along the top flange.

26.7 PLUMBING-UP

26.7.1 Connections. Connections of the equipment used in plumbing-up shall be properly secured. Turnbuckles shall be secured to prevent unwinding when under stress.

26.7.2 Guys. Plumbing-up guys and related equipment shall be positioned so that employees can work on the connection points. The plumbing-up guys shall be removed only under the supervision of a competent person.

26.8 BOLTING

26.8.1 Drift pins. When bolts or drift pins are being knocked out, a means shall be provided to keep them from falling.

26.8.2 Impact wrenches. Impact wrenches shall be equipped with a locking device for retaining the socket.

26.8.3 Containers. Containers shall be provided for storing and carrying bolts, drift pins, and rivets and they shall be secured against accidental displacement when aloft.

26.8.4 Drilling and reaming. Drilling and reaming machines shall be operated by two employees, unless the handle is firmly secured to resist the torque reaction of the machine if the reaming or drilling bit should bind.

26.9 RIVETING

26.9.1 Fire protection. Riveting shall not be done in the vicinity of combustible material unless fire extinguishers or hoselines are readily available to extinguish fires.

26.9.2 Riveting hammers. A safety wire shall be properly installed on the snap and on the handle of the pneumatic riveting hammer and shall be used at all times. The wire shall be not

less than No. 9 (B&S gauge) leaving the handle, and not less than annealed No. 14 or equivalent on the snap.

26.9.3 **Removing rivets.** When rivet heads are knocked off or backed out, a means shall be provided to keep them from falling.

26.10 **FIRE PROTECTION**

26.10.1 **Fire protection.** A fire protection and prevention plan shall be developed prior to erection of any major structure in accordance with subsection 10.3.

26.10.2 **Welding and cutting.** Precautions shall be taken to prevent sparks or fires in accordance with paragraph 16.16.4.

Section 27

RECLAMATION DRILLING STANDARDS

27.1 **GENERAL.** This section establishes safety standards and safe work practices for earth and rock drilling operations. The standards do not apply to drilling powder holes for excavation.

27.2 SITE SELECTION AND WORKING PLATFORMS

27.2.1 **Preparing worksite.** Adequate clearing shall be done to accommodate the drill platform and supplies. In preparing a worksite located on adverse topography, precautions against flooding, caving, slides, and loose boulders must be taken. The drill platform shall be stabilized by outriggers or adequate timbering.

27.2.2 **Underground utilities and overhead lines.** In the vicinity of overhead power transmission or distribution lines, drills shall be set with at least a 15-foot clearance between any part of the drill or mast and the powerline. Further, the drill shall be adequately grounded in accordance with subsection 12.5 of this manual. Prior to beginning drilling operations, underground utilities shall be located and marked so that appropriate clearances from drilling operations can be maintained. See paragraph 12.1.3.

27.2.3 **Drainage.** A drain shall be provided for the drill water to flow from the worksite. The drain shall be extended far enough from the worksite to prevent any undercutting of the foundation.

27.2.4 **Sanitation facilities.** Sanitation facilities shall be provided in accordance with subsection 7.10. Waste disposal shall be in accordance with local sanitation codes.

27.2.5 **Drill platform design.** Drill platforms shall be designed to provide adequate working space.

- a. *Lumber for drill platform.* Lumber used in constructing the drill platform shall be of good quality, straight grained, and free of unsound checks or knots.
- b. *Sill size.* Sills supporting the working deck shall be 4- by 4-inch nominal dimension or greater, spaced on 4-foot centers or less.
- c. *Decking sills.* Decking sills should be spaced so that there is no overhang.
- d. *Deck boards.* Deck boards shall be at least 2- by 10-inch nominal dimension and secured to the sills to prevent movement.

e. *Mud pits and drainage excavations.* Mud pits and drainage excavations should be safely sloped and located to provide minimum interference with work. Where necessary, suitable barricades, catwalks, etc., should be provided to reduce the possibility of injury to persons. Ladders shall be positioned in pits or excavations 5 feet or greater in depth.

27.2.6 **Lighting.** Illumination of all working surfaces shall be a minimum of 5-foot-candles.

a. All electrical wiring for illumination purposes area shall be in accordance with National Electrical Code Standards. All wiring shall be done by qualified personnel.

b. Light bulbs shall be protected and shall be heavy duty, outdoor, nonshattering type.

c. Lighting circuits shall be inspected periodically and defective wiring or fixtures removed from service.

27.2.7 **Flammable liquids.** Flammable liquids shall be stored, dispensed, and handled in accordance with subsection 11.12.

27.3 **SKID-MOUNTED UNITS**

27.3.1 **Control levers.** Labels clearly indicating the function and direction of the control levers shall be posted on the power unit controls of all drills.

27.3.2 **Safety shutoff.** An emergency safety power shutoff device shall be installed within reach of the operator on all units. The device shall be clearly labeled or otherwise made readily identifiable and checked daily to ensure that it is operable.

27.3.3 **Operator.** The power unit shall be operated only by supervisory certified and qualified persons instructed in the operation of the particular equipment.

27.3.4 **Lubrication and repair.** Equipment shall be shut down during manual lubrication and while repairs or adjustments are being made.

27.3.5 **Refueling.** Internal combustion engines shall **NOT** be refueled while running. Where practicable, the gasoline tank should be positioned or shielded to avoid accidental spillage of fuel on the engine or exhaust manifold during refueling operations.

27.3.6 **Unit controls.** Wherever practicable, operating unit controls shall be designed to return to neutral when the control levers are released.

27.3.7 **Gears and moving parts.** Gears and moving parts, constituting a hazard to employees, shall be shielded to prevent accidental contact.

27.3.8 **Fire extinguishers.** A 2-A:40-B:C dry chemical fire extinguisher shall be carried on the unit and removed to a position within 25 feet of the worksite during drilling operations.

Extinguishers shall be inspected at least once every month. Annual maintenance inspection and tagging shall be done by a qualified inspector.

27.3.9 Exhaust systems. Engine exhaust systems shall be equipped with spark arresters when operated in areas where sparks constitute a fire hazard.

27.4 TRUCK-MOUNTED DRILLS

27.4.1 General. Platforms, steps, handholds, and guardrails shall be provided on the equipment to assure safe access and footing. The platform and decks shall be coated with nonskid surface.

27.4.2 Preventive maintenance. An effective preventive maintenance program providing for periodic inspection at such intervals as are necessary to ensure safe operation and adequate maintenance shall be carried out.

27.4.3 Safety line. Truck-mounted drills shall be equipped with a "Safety Line" or with clearly marked and conspicuously located emergency switches (panic buttons). The "Safety Line" emergency stop consists of a taut wire that runs around the back of the machine and connects to a special switch that turns off the power unit when the line is contacted. When emergency switches are used in lieu of a "Safety Line" there shall be a minimum of two. One switch is to be located within easy reach of the operator and one located within easy reach of helpers at ground level near the drill or auger head.

27.4.4 Truck movement. Trucks shall **NOT** be moved backwards, unless the driver has personally inspected the area behind the truck. In restricted or congested areas or areas where workers are located, the assistance of a "spotter" is mandatory. Trucks shall be equipped with serviceable automatic backup alarms.

27.4.5 Raising mast. Before raising the mast, personnel shall be cleared from the immediate area with exception of the operator and a helper when necessary. A check shall be made to ensure safe clearance from energized powerlines or equipment. Unsecured equipment shall be removed from the mast before raising. Cables, mud lines, and cat line ropes must be adequately secured to the mast before raising.

27.4.6 Securing mast to rig. After raising, the mast shall be secured to the rig in an upright position with steel pins.

27.4.7 Moving drill equipment. Prior to moving drill equipment a thorough inspection shall be made to ensure that the mast, drill rods, tools, and other supplies and equipment are secured to prevent displacement while in transit. Applicable traffic laws shall be observed in moving drill equipment over public roads. A check shall be made of steering mechanism, brakes, lights, load limits, and proper flagging or lighting of load extensions.

27.5 SURFACE DRILLING OPERATIONS

27.5.1 **General.** Before starting the power unit, all gears shall be disengaged, cable drum brake set, and no rope shall be in contact with the cathead.

27.5.2 **Safety chains.** A safety chain and cable arrangement shall be used to prevent water swivel and mud line whip.

27.5.3 **Water swivels and hoisting plugs.** All water swivels and hoisting plugs shall be checked for possible frozen bearings and shall be properly lubricated before use. A frozen bearing could cause mud line whip and injury to the operator.

27.5.4 **Braking operation.** Only the drill operators shall brake or set the chucks, to eliminate the possibility of engaging the transmission prior to removing the chuck wrench.

27.5.5 **Chuck jaws.** The chuck jaws shall be periodically checked and replaced as necessary.

27.5.6 **String of drill rods.** A string of drill rods shall **NOT** be braked, during lowering into the hole, by the chuck jaws. A cat line or hoisting cable and plug should be used for braking prior to tightening of the chuck. Failure to follow this procedure will result in steel slivers on the rods, possible hand injuries, and loss of the rods down the hole.

27.5.7 **Lowering drill rods.** Drill rods shall **NOT** be lowered into the hole with a pipe wrench. Serious back and hand injuries may result if the rods are lowered by this method.

27.5.8 **Drilling with air.** When drilling with air is required, the exhaust shall be directed into a dust collection system. The cuttings shall be directed to the side away from employees.

27.5.9 **Cleaning drill rods.** When using drilling fluids, a rubber or other suitable wiper shall be used to remove the material from the drill rods when removing them from the drill hole.

27.5.10 **Pipe wrench jaws.** Pipe wrench jaws should be checked periodically and replaced as they become worn.

27.5.11 **Draining of drill rods.** Drill rods should be allowed to drain completely following braking before removal from the working area.

27.5.12 **Hoisting of drill rod.** Care must be exercised by the operator to avoid a sudden hoist release of the drill rod while the rod is being carried from the hole.

27.5.13 **Hoist capacity.** The hoisting capacity and weight of the drill rod must be known to prevent collapse of the mast during drill string removal from the hole. The operating capacity of the mast and hoist shall **NOT** be exceeded.

27.5.14 **Cleaning of auger flights.** Cleaning of auger flights shall **NOT** be done while the auger is rotating. A special paddle should be designed for cleaning auger flights or, if available, water under pressure is recommended for jet cleaning.

27.5.15 **Auger sections.** The use of mismatched auger sections should be avoided. Different brands and different weights shall **NOT** be used in the same auger flight.

27.5.16 **Fitting pins.** Only tight-fitting pins designed for the auger shall be used. Some pins lose their temper after very little use and the spring or clip section fails to hold the pin securely.

27.5.17 **Drill hole protection.** Unattended drill holes shall be adequately covered or protected to avoid the possibility of animals or people accidentally falling into them.

27.5.18 **Equipment inspection.** Daily inspections prior to using equipment shall be made. This inspection should include a thorough check of the hydraulic hoses, connections, and valves. Deficiencies should be corrected or safe condition verified before starting the equipment.

27.5.19 **Warning signs.** A durable warning sign shall be installed on all equipment in full view of the operator containing the following wording:

- a. All personnel must be clear before starting machine.
- b. Stop the auger to clean it.
- c. Stop engine when repairing, lubricating, or refueling.
- d. Do not wear loose fitting clothing or gauntlet-type gloves.

27.6 UNDERGROUND DRILLING OPERATIONS

Note: In addition to the following safe practices, refer to section 23 and Safety and Health Regulations for Construction, Title 29 CFR Part 1926 Subpart S - "Tunnels and Shafts, Caissons, Cofferdams, and Compressed Air."

27.6.1 **Access.** Safe means of access shall be provided and maintained to all underground working places.

27.6.2 **Lowering and hoisting equipment in shafts.** Heavy equipment shall **NOT** be carried down ladders into a shaft. Mechanical hoisting devices shall be provided for lowering and hoisting equipment in a shaft exceeding 50 feet in depth.

27.6.3 **Unattended shafts.** Access to unattended shaft openings shall be restricted by barricades equipped with gates or doors. Subsidence areas that present hazards shall be fenced and posted.

27.6.4 Evacuation plan. Prior to a startup, evaluation plans and procedures shall be developed and made known to all employees.

27.6.5 Underground ventilation. Ventilation for underground work areas shall be mechanically ventilated in accordance with subsection 23.3 and provide a minimum of 100 cubic feet of air per minute for each employee.

27.6.6 Scaling work areas. Work areas shall be thoroughly scaled prior to any drilling operations and periodically during all underground work.

27.6.7 Walkway. A clear walkway must be maintained and no equipment or materials shall be permitted to obstruct the passageway.

27.6.8 Drainage. Drainage away from the worksite should be provided and maintained.

27.6.9 Lighting. Sufficient lighting shall be installed and maintained in work areas and access ways. A minimum illumination intensity of 5 foot-candles is required in work areas.

27.6.10 Electric service lines. Electrical service lines shall be insulated, strung on insulators, and separated from water, air, or telephone lines.

27.6.11 Hardhats. Employees shall wear nonconductive insulated hardhats conforming with ANSI Z89.1, Class B.

27.6.12 Dust respirators. Bureau of Mines-approved dust respirators shall be worn when dust concentrations may exceed the safe hygiene limits. When respirators are required, they shall be provided and worn in accordance with subsection 8.4.

27.6.13 Miner's lamps. Miner's lamps shall be provided and worn by all employees working underground. Lighting system shall be installed to provide illumination in accordance with subsection 7.14.3.

27.6.14 Ear protection. Ear protection shall be worn when sound level exposure exceeds 85 dBA.

27.6.15 Rain clothing. Rubber rain suits shall be provided and worn where conditions warrant.

27.6.16 Anchors. Installation of rock bolts for anchoring or pulling devices must be done in accordance with approved mine safety standards. All rock bolts shall be adequately torqued in accordance with manufacturers' recommendations.

27.6.17 Column mount drill units. All column mount drilling units shall be securely stabilized with necessary timbers and wedges adjacent to column footplates. Wedges shall be driven to place and nailed to adjacent timbers to prevent vibration movement.

27.6.18 **Flammable liquids or gases.** Except for welding and cutting, no flammable liquids or gases shall be allowed underground.

27.6.19 **Air lines.** Air lines exceeding 1/2 inch in diameter shall be equipped with safety-type couplings and secured with wire or chain at each coupling to prevent whipping in event of failure. Air hoses shall **NOT** be disconnected until shut off and bled to reduce the pressure.

Section 28

STAGE WORK IN ENERGIZED FACILITIES

28.1 GENERAL

28.1.1 Definitions

- a. Stage work is defined as construction, repair, alteration, or erection of equipment or structures in an energized facility.
- b. Energized facilities are defined as substations, switchyards, and pumping plants and powerplant sections where personnel are exposed to unguarded energized electrical circuits and equipment of 600 volts or greater, and employer designated locations in or associated with pumping plants and powerplants.

28.1.2 Requirements. All stage activities in energized facilities shall conform to requirements of this section and other applicable sections of the standards, reference publications, and the specifications. In case of conflicts between such requirements, the more stringent will prevail unless otherwise noted in this section.

28.1.3 Authorization, supervision, and inspection. No work shall be performed in energized facilities until authorization to proceed is obtained from the employer. All work shall be performed under the immediate supervision of a qualified foreman and observation by a Reclamation representative.

28.1.4 Contractor responsibility. The contractor shall exercise extreme care and take necessary precautions for the safety of employees and others in performing construction operations in energized facilities. The contractor shall be responsible for performing work in such a manner as not to endanger personnel, existing power equipment and facilities, or to cause interruption in electrical service.

28.1.5 Energized facilities. Work by Reclamation or contractor forces on energized buses, circuits, and other electrical equipment will not be required nor permitted unless specifically required by the contract specifications or O&M policies. If a portion of the work to be done is in the immediate vicinity of energized sections of the facilities, Reclamation and/or the contractor shall be responsible for securing information as to what facilities are energized, taking all necessary precautions for the safety of personnel, and keeping employees fully informed, including safe work limits.

28.1.6 Jurisdiction. The facilities and electrical equipment are subject at all times to Government SOP (standing operating procedures) and regulations. These regulations require

use of formal clearance procedures with provision for protective lockout/tagout devices and grounding of that portion of the equipment necessary to perform the work under contract or as required by the SOP. The regulations provide for "hot line orders" on exposed energized circuits immediately adjacent to the work.

Normally, provision is made to deenergize only those buses and circuits as necessary to accomplish the work. Such deenergization is ordinarily carried out on a progressive, preplanned basis, determined by the progress of the work. Also, certain operating facilities will be released only at prescheduled times during the day, such as off-peak periods, in order to maintain continuity of commercial electrical service. Under these conditions, it is essential that Reclamation or the contractor closely plan operations to fully utilize time afforded by the clearance. Close supervision of operations is required in order that all necessary precautions are taken for the safety of employees, the protection of existing facilities, and uninterrupted power.

28.2 CLEARANCES AND SPECIAL WORK PERMITS. (FIST Volume 1-1 outlines requirements for hazardous energy control procedures and restrictions for clearances and special work permits.

28.2.1 Clearances. Clearances for work are required for deenergizing and isolating operating systems within a facility. When the work is in close proximity to exposed energized circuits or equipment components, hot line orders are required. Absolutely no work shall be done under these conditions until such clearances are secured and a special work permit has been issued. Issuance of clearances, hot line orders, and special work permits are handled in accordance with FIST Volume 1-1, "Hazardous Energy Control Program." The following procedure shall be followed in securing special work permits:

- a. No work requiring an outage or hot line order shall be performed without first securing a special work permit. In requesting a special work permit for a specific phase of work requiring a clearance or hot line order, the employer shall make a written request to the COR or office head. (Refer to FIST Volume 1-1, sec. 16.1.) The request shall include a plan of operation indicating the work to be done, the sequence of operations, the period of work, description of equipment to be used, safety precautions to be taken, and type and location of barricades, warning signs, protective grounds, and devices to be used to perform the work.
- b. Following approval of the contractor's plan of operation, the responsible Reclamation onsite representative will secure a clearance or a hot line order, as appropriate, from the power operations supervisor. The Reclamation onsite representative will, in turn, outline the work area to the worksite contractor representative or Reclamation employee responsible for the work, and then issue a special work permit authorizing the work to proceed.
- c. The special work permit will indicate the limits of the work area, restrictions, and conditions pertinent to the clearance or hot line order. The special work permit shall be

signed by the Reclamation onsite representative securing the clearance or hot line order and contractor's or Reclamation's representative at the jobsite, and a copy retained by both.

d. The employer shall review the approved plan with all employees and subcontractors before proceeding with the work, and as frequently thereafter as necessary to ensure that they have full knowledge of the plan of operation and the required safety precautions.

28.3 GROUNDING REQUIREMENTS

28.3.1 Requirement

a. Personal protective grounding procedures and equipment shall conform with these requirements and applicable provisions of FIST Volume 5-1 "Personal Protective Grounding." Conflicts between the grounding and bonding procedures required by this section, referenced requirements of the specifications, and those specific to the worksite facility shall be resolved prior to the employer starting onsite work. The agreed upon procedure will be reduced to written form and become a part of all work permits issued.

b. All electrical circuits and equipment, normally operated in excess of 600 volts, shall be considered energized until disconnected from all sources of electrical energy, a clearance or special work order obtained, and the circuits and/or equipment properly grounded. If possible, the grounds shall be placed within sight of the workers. The employer representative holding the clearance or special work permit shall be personally responsible to ensure the proper placement and removal of the protective grounds.

28.3.2 Ground leads. For normal stage work, the minimum size of ground leads shall have an ampacity greater than No. 2/0 AWG copper or equivalent. Normally, ground-leads should not exceed 40 feet in length.

28.3.3 Testing. A hot-stick, "noisy tester" or similar-approved device of sufficient insulating capacity shall be used to verify the fact that the circuit is deenergized prior to placement of grounds.

28.3.4 Placement and removal. Protective grounding cables shall be installed so that all phases of lines and equipment are visibly and effectively bonded together in a multiphase "short" and connected to ground at one point. Protective grounds shall be installed on both sides of the work area. When attaching grounds, the ground end shall be attached first and the other end attached to the deenergized circuit by means of a hot stick of sufficient insulating capacity. When removing grounds, the grounding clamp shall first be removed from the deenergized circuit using a hot stick of sufficient insulating capacity. Use of single-phase grounds and grounding chains is prohibited.

28.4 RESTRICTED AREAS

28.4.1 Requirement. All areas of the facility other than the deenergized areas and access ways specifically set forth in the special work permit shall be considered restricted areas. No employees shall enter a restricted area except under the immediate supervision of an employer foreman. All restricted areas shall be considered energized areas and the specific safety precautions to be taken when entering such areas shall be approved by the employer.

28.4.2 Barricades and signs. All designated work areas and access ways, as described in the special work permit, shall be isolated from the restricted areas by approved barricades and signs. The employer shall furnish, erect, and maintain all such barricades and signs. They shall be erected prior to starting work in the designated work areas. The employer shall be fully responsible for isolating the safe work areas and access ways and keeping employees out of restricted and hazardous areas. Approved barricades and signs shall be as described in the following paragraphs:

- a. *Approved barricades.* Approved barricades shall be constructed of at least two spans of 1/2 inch or greater, yellow or orange synthetic fiber rope completely encompassing the safe work area and accessways, restricting entry to all restricted and/or hazardous areas. The top span shall be approximately 60 inches above the surface of the safe work area and the intermediate span approximately 36 inches high above the surface. Approved barricades shall be erected at substation ground level and at all levels in the buswork or structures where employees are required to work. They shall be positioned in such a manner that no employee can contact energized lines or equipment without violating the barricade. Additional barricades may be necessary dependent upon existing field conditions and all barricades shall be subject to approval of the employer.
- b. *Approved-type signs.* Danger signs, as described in paragraph 9.2.3, shall be of nonconductive material and at least 10 by 14 inches in size. One shall be suspended at midspan of each section of all barricades except in the bus-work or structures where such signs shall be placed directly above all beams entering the restricted area. The danger signs shall contain the following wording: **"HIGH VOLTAGE---KEEP OUT."**

28.5 ADDITIONAL SAFETY REQUIREMENTS

28.5.1 Control panels. Only qualified and experienced switchboard electricians shall be permitted to work on energized control panels. Adequate precautions, including the use of accident prevention tags, shall be taken to prevent accidental operation of switches. Also, care shall be taken to prevent operation of relays or other protective devices due to jarring, vibration, contact, or improper wiring.

28.5.2 Mechanized equipment. Movement of vehicles, gin poles, cranes, and other hoisting or mechanized equipment used in substations shall be controlled by a signal or flag person.

28.5.3 Grounding mobile equipment. Mobile equipment with booms or extensions above the cab level shall be equipped with a minimum No. 1/0 extra-flexible copper or equivalent ground lead. The equipment shall be bonded to the station ground mat when being operated in a stationary position.

28.5.4 Material storage. No materials or equipment shall be stored under an energized bus or line or near energized equipment.

28.5.5 Handling materials. Extreme caution shall be exercised in the handling of bus or tower steel, or other materials of a length that could contact energized facilities. Such materials shall not be carried on the shoulder.

28.5.6 Substation fences. When a substation fence must be extended or removed, a temporary fence affording comparable protection shall be erected. Such temporary fencing, when constructed of metal, shall be bonded to the existing fence. All substation gates shall be kept closed and locked except when work is in progress and access can be controlled.

28.5.7 Operating equipment near high-voltage lines. Operation of equipment near energized high-voltage lines or facilities shall conform to the requirements and distance restrictions set forth in subsection 12.9.

28.5.8 Completion of work. When all work in a particular facility is completed, written notification will be given to the employer to remove all grounds and not to perform any further work in the area.

Section 29

MARINE AND DIVING OPERATIONS

29.1 MARINE OPERATIONS

29.1.1 Inspection and certification. All watercraft and equipment shall be inspected, certified, licensed, and numbered as required under the regulations of the U.S. Coast Guard or other jurisdictional entities before being placed in service.

29.1.2 Operator's license. The master, pilot, and crew of watercraft shall have in their possession a current license or certification as required by the U.S. Coast Guard or other jurisdictional entities. Operators of motor vessels 26 feet or longer, or vessels assigned to transport more than 10 persons shall possess a current U.S. Coast Guard Motor Board Operator's License. Reclamation operators shall be certified by a DOI-certified instructor in accordance with DM 485 or an equivalent Denver- or Regional Office-approved certification program.

29.1.3 Inspections. Prior to use, all watercraft and equipment shall be inspected and tested by a qualified person and determined to be in safe operating condition. Periodic inspections shall be made thereafter to ensure safe operating condition. Watercraft found to be in unsafe condition shall be removed from service until the unsafe condition has been corrected.

29.1.4 Capacity plates. All watercraft shall have plainly marked thereon the maximum number of persons that can safely be carried, and the number shall not be exceeded.

29.1.5 Personal flotation devices (PFD). Personal flotation devices as specified in subsection 8.11 shall be worn by the crew and passengers traveling on or working from all launches, motorboats, outboards, skiffs, dredges, and floating platforms, unless employees are protected by standard guardrails. Where exempted from wearing PFD, a PFD for each crew member and passenger will be readily available aboard the watercraft. A throwable ring life preserver shall be readily available for passengers and crew.

29.1.6 Fire extinguishers. At least one U.S. Coast Guard-approved dry chemical fire extinguisher, rated at least 2-A:40-B:C, shall be carried on all launches and motorboats including outboards. Launches and motorboats having gasoline or liquid petroleum gas powerplants located in a confined space shall be equipped with a built-in automatic CO² (carbon dioxide) or equally effective automatic fire extinguishing system.

29.1.7 Gasoline-powered motorboats. Gasoline-powered motorboats or launches, except outboards, shall be equipped with a mechanical exhaust system for ventilating the engine space and bilges. The system shall be interlocked with the ignition to ensure venting prior to starting.

Launches and motorboats having diesel powerplants shall have a mechanical ventilation system or be equipped with a natural draft system consisting of permanently open inlet and outlet ducts extending into the bilges.

29.1.8 **Fuel.** Fuel valves shall be provided on all fuel feedlines and shall be closed during inoperative periods exceeding 8 hours.

29.1.9 **Carburetors.** Carburetors on gasoline engines shall be equipped with a backfire trap or flame arrestor.

29.1.10 **Operation safety.** All boats shall have sufficient space for cargo and passengers and shall not be overloaded. Swimming shall be prohibited from all floating equipment except for certified divers in the performance of their duties. Cables across waterways between floating equipment or the equipment and mooring shall be plainly marked and, if necessary to protect the public, guarded by strategically placed buoys or other floating devices. All floating craft shall be equipped with an audible warning or signaling device. Due consideration shall be given to weather and water conditions, and all operations shall be suspended in the event of storms rendering operations unsafe.

29.1.11 **Floating pipelines.** All floating pipelines used as accessways shall be equipped with a walkway and handrail on one side. Personnel using the walkway or working on the line shall be protected by PFD or work vest as specified in paragraph 8.11.1.

29.2 CONTRACTOR DIVING OPERATIONS

29.2.1 **General requirements.** Conventional hardhat and lightweight surface supplied and scuba diving operations shall be governed by the more stringent requirements of this subsection or 29 CFR, Part 1910, Subpart T, "Commercial Diving Operations." Regulations contained in the U.S. Navy Diving Manuals, Volumes I and II, shall be used to resolve issues not covered by these or referenced standards. No diving equipment shall be brought to the worksite until a Safe Practices Manual, Diving Plan, and JHA (job hazard analysis) have been developed and accepted by the COR. The JHA or diving plan shall specifically address safety procedures for each separate diving location or mode and contain policies that ensure compliance with these and referenced standards.

29.2.2 Contractor surface-supplied air diving

a. *Diver qualifications.* Divers, including those on standby, shall possess evidence of qualification in the form of a certificate of training from a recognized diving school or certified record of past diving experience. Divers shall be at least 18 years of age, be fully familiar with the equipment and diving system to be used, and possess evidence of a medical examination within the previous 12 months which certifies that the diver is physically fit for diving. In addition, no one shall be employed as a deep diver unless he/she has been gradually introduced or reintroduced to the maximum depth at which he/she is to dive. Divers suffering from severe colds, sinus, or ear trouble, alcoholic

intoxication or its aftereffects, drug addiction, fatigue, acute illness, or vertigo shall not be permitted to participate in diving operations.

b. *Supervision.* All diving operations including utilization of personnel and decompression, shall be under the personal supervision of a competent Dive Master.

c. *Minimum crew size.* A minimum of two divers shall be available on any one diving operation. The standby diver shall be available, suited up, and ready to dive in an emergency, and shall not serve as a tender. The minimum crew shall consist of at least four persons: the Dive Master, a diver, a standby diver, and a tender. For each diver added to the crew, one tender shall also be added.

d. *Auxiliary air supply.* An auxiliary air supply consisting of a standby compressor or air flasks shall be available during all dives. Compressors used in diving operations shall be independent of any other use.

e. *Decompression.* Decompression tables shall be prepared by recognized decompression specialists. Decompression times shall be posted inside and outside of decompression chambers.

f. *Decompression chamber.* An onsite dual lock, multiplace decompression chamber capable of recompressing the diver to a minimum of 165 feet seawater equivalent complete with trained operating personnel shall be required (1) in diving operations outside the no-decompression limits or to depths deeper than 100 feet seawater, (2) for all diving operations where an offsite chamber is not reasonably available for emergency use, or (3) when surface recompression capabilities are recommended by the decompression specialists or Dive Master or found necessary by onsite conditions. All chambers shall accommodate a minimum of two persons.

g. *Decompression dives.* Divers engaged in dives outside no-decompression limits or engaged in mixed-gas diving shall remain awake and in the vicinity of an attended decompression chamber for at least 1 hour after the dive. The diver shall be able to contact a decompression chamber facility during the 4-hour period immediately after treatment or leaving the water.

h. *Communications.* Divers and standby divers shall be equipped with telephones permitting simultaneous two-way conversations between the diver, his tender, other divers, and other tenders and the Dive Master.

29.2.3 Contractor mixed-gas diving. Mixed-gas diving is prohibited unless required by specifications or approved by the COR prior to development of the diving plan.

29.2.4 Contractor scuba diving

a. *Requirement.* Scuba diving shall not be permitted unless sanctioned by the contract specifications or authorized in writing by the contracting officer. All requests for such authorization shall contain the following information and shall be subject to the requirements of this subsection:

1. Names and qualifications of divers to be used in the operation.

2. A complete description of the proposed diving operations including equipment to be used and a JHA.

b. *Maximum depths.* Scuba diving shall be limited to depths and to times that will not require decompression staging as set forth in the U.S. Navy Standard Decompression Tables. Scuba dives shall not exceed 100 feet seawater equivalent (FSW) in depth before altitude adjustment. Dives shall not exceed 130 FSW after altitude conversion.

c. *Compressed air.* The use of scuba diving equipment shall be limited to the open-circuit type using compressed air only. Use of oxygen or mixed gases or semiclosed-circuit scuba shall not be permitted.

d. *Diving equipment.* Scuba diving equipment shall be of a type that has been approved by a recognized approving agency, and the equipment shall be used and maintained in accordance with the manufacturer's recommendations.

e. *Diver qualifications.* Scuba divers shall possess the qualifications and present evidence of medical examinations as set forth in subparagraph 29.2.2a.

f. *Supervision.* All diving operations shall be under the direction of a diving officer with a designated, experienced, onsite Dive Master.

g. *Buddy system.* Scuba dives less than 33 feet in depth in lakes or reservoirs where there is little current may be made singly at the option of the Dive Master. In dives over 33 feet in depth, the buddy pair system shall be used when working in structures or locations (such as ice cover) where orientation is critical in nature or against currents exceeding 1 knot, a tether line shall be attached to the diver. Buddy pair divers must maintain visual contact or use a buddy line securely fastened to both divers. When working in fast currents, murky water, or in confined spaces, a tether line shall be attached to the diver and it shall be continuously tended from the surface.

h. *Surface tenders.* A surface tender shall be provided for each diver or buddy pair. The tender shall be a qualified and fully equipped scuba diver, located on the surface in close proximity to the diver.

- i. *Emergency equipment.* Scuba divers shall wear buoyancy compensators and have a watch, compass, depth indicator, and a knife on all dives.

29.3 RECLAMATION DIVING OPERATIONS.

29.3.1 **General.** It is required that Reclamation dive team members be well trained, proficient, and properly equipped. It is the responsibility of the Regional Directors to see that these requirements are met. A shortage of manpower or funds will not be an acceptable reason for noncompliance with these regulations. Failure to comply with these regulations shall constitute reason for suspension of the team's diving operations.

29.3.2 **Policy and guidelines.** The policies and guidelines for Dive Team establishment, review, training, certification, and diver qualifications are found in RI Part 379 and shall be complied with as part of this manual.

29.3.3 **Accidents and incidents.** All accidents occurring in connection with a diving activity shall be reported in accordance with standard accident reporting procedures. In addition, the leader of the affected team shall submit to the Regional Director, a comprehensive analysis of each accident or near accident involving a diver. The near-accident analyses are intended primarily for the purpose of identifying hazardous situations and providing a constructive basis for preventing their reoccurrence.

29.3.4 **Diving supervision.** The Team leader or an appointed Dive Master shall be in attendance on each diving operation. The Dive Master will be responsible for the pre-dive planning, a JHA, conduct, and safety of the dive; his/her decisions are final. However, no diver shall be required to participate in any diving operation which he or she considers unsafe.

29.3.5 **Three divers required.** A minimum of three divers shall be present on all Reclamation dives.

29.3.6 **Team member ethics.** Team members are expected to conduct themselves in an ethical manner with respect to fellow team members and to the general public as prescribed by the Secretary of the Interior, Part 20 of Title 43 as published in the *Federal Register*.

29.3.7 SCUBA DIVING

- a. *Compressed air.* The use of scuba diving equipment shall be limited to the open-circuit type using compressed air only. Use of oxygen or mixed gases shall not be permitted. Compressed air will be obtained from an approved source in accordance with ANSI/CGA G7.1, "Commodity Specification for Air."

- b. *Maximum depth.* Scuba diving operations shall be limited to depths and times that will not require decompression staging in accordance with the U.S. Navy tables and the conversion tables as developed by R.L. Bell and R.E. Borgwardt (1975). Dives shall not

exceed 100 feet seawater in depth before altitude adjustment. Dives shall not exceed 130 feet seawater after altitude conversion.

c. *Standby diver.* A standby diver shall be provided for each working unit or pair of divers. The standby diver shall have all diving gear readily available. The standby diver shall be located to observe operations and to facilitate a quick response to the needs of the divers.

d. *Tether lines.*

1. When working in structures or locations (such as ice cover) where ingress and egress are specifically at a single point and where orientation is critical in nature or against currents exceeding one knot, a tether line shall be attached to the divers. [Refer to OSHA 29 CFR 1910.424(b)(3)]

2. Each tethered diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body.

3. The tether line shall be of at least 1/2 inch synthetic material with a breaking strength of at least 2,650 pounds. The tether line shall be marked in 10-foot increments to 100 feet, beginning at the divers end and in 50-foot increments thereafter.

e. *Buddy system.* All scuba diving shall be conducted by a buddy system of two divers working together to assure effective communication with each other throughout the diving operation; except that when in the judgment of the Dive Master the operation of two divers in close proximity will increase the hazards of the activity, a single diver may work alone subject to the following conditions:

1. The working depth does not exceed 50 feet.

2. A surface line tender and standby diver shall be provided for the single diver.

3. The Dive Master, surface tender, standby diver, and diver clearly understand the diver will be working alone.

4. The Dive Master, the surface tender, standby diver, and the diver shall agree in advance on the exact operation. The diver shall not alter the prescribed operation nor stray from the prescribed locality.

5. The single diver must be continuously line tended.

f. *Project representative.* When diving is taking place in the vicinity of dams, power plants, pumping plants, diversion structures, or other facilities where operations could

cause rapidly changing flow conditions, a technical representative from the project at which the dive is being made shall be present to assist the divers. The technical representative shall be familiar with the civil and mechanical features of the dive site, local communications and emergency procedures, and the dive hazard analysis.

g. *Clearance and lockout procedures.* When divers are working in the vicinity of civil, mechanical, or electrical features that could pose a hazard to the divers, clearances shall be established to provide a safe working environment. Clearance procedures and lockouts shall be in accordance with FIST Volume 1-1 and section 15 of this manual. All divers shall review the clearance prior to beginning diving operations.

h. *Pressure differentials.* Diving operations shall not be conducted on the upstream or high pressure side of open or badly leaking gates, valves, diversion structures or other features where a combination of flow and pressure differential could pin a diver.

i. *Equipment.* Each diver shall be equipped as recommended by the RDAC (Regional Diving Advisory Committee), except that no diver shall be required to dive using a type or brand of equipment with which he/she does not feel safe. The following basic auxiliary requirement for each diver should include, but not be limited to:

1. Buoyancy compensating capacity
2. Depth indicating device
3. Watch or bottom timer equivalent
4. Knife
5. Compass (optional)
6. Pressure gage to monitor tank air pressure
7. Alternate 2nd stage air source such as octopus or buoyancy compensator with built-in regulator.

j. *Air cylinders.* All air cylinders shall have a visual internal inspection annually and shall be cleaned and scoured as required. The cylinders shall be hydrostatically tested every 5 years in accordance with the Department of Transportation regulations. The date of the last test must be recorded on the tank.

k. *Diving flag.* A diving flag shall be flown at all times when the divers are working in the vicinity of motor boats or other dangerous watercraft.

l. *Surfacing.* Divers must surface as quickly as is safely possible when the tank pressure drops to 300 pounds per square inch.

m. *Recompression chamber.* The locations and telephone numbers of the nearest recompression chamber shall be on hand for each dive operation as a part of the dive plan and safe practices manual. The Dive Master shall verify the status and location of the chamber and most effective mode of transportation to the chamber as part of the dive hazard analysis.

n. *Decompression tables.* Decompression tables shall be available at the dive site as part of the dive plan and safe practices manual. The table shall never be copied for use except by a photographic method which reproduces an exact copy.

o. *Emergency medical equipment.* The dive team must have emergency first aid equipment immediately available. The dive plan and JHA shall have information available as to the location and telephone number of an emergency first aid station or hospital close to the dive area. Emergency first aid equipment should include a spineboard and demand-type oxygen unit.

p. *Postdive restrictions.* Within 12 hours after completing a dive or 18 hours after 3 continuous days of diving, diving personnel shall not travel in any mode of transportation that will cause the "no decompression limits" to be exceeded.

q. *Individual safety.* Each individual diver must realize that ultimately he/she is responsible for his/her own safety. It is the diver's responsibility and privilege to refuse to dive if, in the diver's judgment, conditions are unsafe or unfavorable or if in diving they would violate the dictates of their training, judgment, or these regulations.

r. *Transportation of equipment.* All dive cylinders shall be transported in a horizontal, bottom forward position, or in an upright position and properly secured. They must be shaded at all times and the temperature maintained at less than 100 °F whenever possible. In the event temperature cannot be controlled, the pressure must be reduced so as not to exceed the maximum cylinder working pressure.

29.3.8 Reclamation SSA (surface-supplied air) diving. SSA diving shall be permitted only if divers and standby divers and tenders have received training on SSA equipment and SSA diving procedures and safe practices by an RDAC-approved instructor.

a. *Compressors.* Compressors used to supply air to the SSA diver shall be equipped with a volume tank with a check valve on the inlet side, a pressure gage, a relief valve, a drain valve, and a carbon monoxide filter and alarm system. Compressors shall be of sufficient capacity to overcome any line loss or other losses and deliver a minimum of 4.5 actual ft/min (feet per minute) to each diver at the maximum working depth.

b. *Equipment records.* Each equipment modification, repair, test, calibration, or maintenance service shall be recorded in the equipment log.

c. *Intakes.* Air compressor intakes shall be located away from areas containing exhaust or other contaminants.

d. *Air quality.* Respirable air supplied to a diver shall be tested every 6 months and not contain:

Carbon monoxide greater than 20 p/m
Carbon dioxide greater than 1,000 p/m
Oil mist greater than 5 mg/cubic meter
A noxious or pronounced odor

e. *Umbilicals.* Umbilicals shall be marked in 10-foot increments to 100 feet, beginning at the divers end and in 50-foot increments thereafter. Umbilicals shall be made of kink resistant materials. A safety line of at least 1/2-inch synthetic material shall be included as an integral part of each umbilical. Umbilicals shall have a nominal breaking strength of at least 2,650 pounds.

f. *Helmets.* SSA helmets and masks shall have a non-return valve at the attachment between the helmet or mask and hose which will close readily and also have an exhaust valve. Helmets and masks shall have a minimum ventilation rate capacity of 4.5 ft/min at the depth at which they are operated.

g. *Weight belt.* Except when heavy gear is worn, divers shall be equipped with a weight belt capable of quick release.

h. *Safety harness.* Each diver shall wear a safety harness with a positive buckling device, an attachment point for the umbilical and safety line, and a lifting point to distribute the pull of the line over the diver's body.

i. *Dive tender.* Each diver shall be continuously tended while in the water with one tender per diver.

j. *Confined space.* A SSA diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

k. *Breathing air supply.* Each diving operation shall have a primary breathing air supply sufficient to support divers for the duration of the planned dive, including emergency decompression.

l. *Standby diver.* A SSA standby diver will be dressed out and ready for immediate deployment while a diver is in the water.

m. *Reserve breathing air.* Each diver must have a reserve breathing supply available which can be turned on immediately by the diver in the event of loss of air.

n. *Reserve breathing air supply.* Each dive location shall have a reserve breathing air supply in-line, capable of supporting the total dive operation.

o. *Communication system.* Electronic communication systems shall be incorporated in all SSA diving operations. All diving shall be terminated if voice communications are lost.

p. *Prohibited use.* Use of the Jack Browne or similar mask is prohibited.

Section 30

DEMOLITION

30.1 **REQUIREMENT.** All demolition operations and equipment shall conform with applicable provisions of section 7, other applicable referenced standards, and 29 CFR Part 1926, "Safety and Health Regulations for Construction," Subpart T, "Demolition." In the event of conflict between these and referenced standards or regulations, the more stringent provision shall prevail.

30.1.1 **Programs.** Written programs shall be developed for demolition and disposal of structures likely to contain hazardous material such as asbestos and lead. The written programs shall be submitted to the employer prior to beginning the demolition work.

INDEX

SUBJECT	SECTION/ SUBSECTION/ PARAGRAPH
A	
Abrasive blasting	
Protective clothing	25.4.1
Respiratory protection	8.4.5, Appendix C
Abrasive wheels	
General	16.3.1, 16.3.2
Eye, face protection	8.3, Appendix A
Protective clothing	8.6.5
Respiratory protection	8.4, Appendix C
Accident investigation	2.13
Accident prevention tags	9.3
Accident reporting	2.13
Serious and fatal	2.13.1
Statistical	2.14
Acids, caustics, and harmful	
Gloves	8.6.3
Respiratory protection	8.4, Appendix C
Skin protection	8.7
Acronyms and abbreviations	1.6
Aerial lifts	13.21.1, 18.1.4, 18.1.6, 18.12
A-frame trucks	18.13.4, 19.13
Agricultural and industrial	19.10
Type equipment (also see Brakes)	
Air, breathing	
Atmosphere	2.16, 7.8.3a, 8.4, 16.16.4c 22.1.8, 22.1.21, 23.4.1
Compressed	8.4.9, 23.14 29.2.4c, 29.3.7a
Supplied air	8.4.8, Appendix C
Respirators	8.4.5, 8.4.6, Appendix C
Testing	8.4.2, 23.4.2
Aircraft	18.13.8
Air compressors	16.2, 16.13
Airhoses	16.2.2, 16.2.5, 16.13.9
Drilling	23.9.1
Air receivers	16.13.5

Air tools	16.2, 23.9
Ambulance service	4.3
Arc welding and cutting	16.18, 16.19
Asbestos	7.3, 7.14.8, 30.1.1
Asphalt and tar	11.13
Audible alarms	18.2.7, 18.3.9, 18.4.8, 18.15.3, 19.7.3, 19.10.9, Appendixes U, V, and W
Augering	121.3, 27.5.14, 27.5.15

B

Backup alarms	19.7.3, 19.8.8, 19.9.9, Appendixes U, V, and W
Barricades	9.2.8, 14.9.2, 19.6.6, 28.4.2, Appendix U
Battery charging	12.8
Belts (see Safety Belts)	
Belts, gears, and shafts	16.1.3, 19.14.2, Appendix U
Biological Monitoring	7.4
Blasting operations	24, Appendix N
Blaster qualifications	24.1.3
Blasting agents	23.1.7, 24
Blasting mats	24.7.11
Blasting signals	24.9.3
Detonating cord	24.13
Electric blasting	24.8
Electromagnetic radiation, RF	24.2
Firing	24.9
Handling explosives	24.6
Inspection, blast	24.10
Loading	24.7
Misfires	24.11
Safety fuse	24.12
Smoking	24.1.7
Storage of explosives	24.5, Appendix N
Stray currents (extraneous electricity)	24.7.8
Surface transportation	24.3
Thunderstorms	24.1.8
Underground transportation	24.4
Underwater blasting	24.14
Vibration damage control	24.1.9
Wiring operations	24.8

Bloodborne pathogens	7.12
Boatswain's chairs	13.9
Boilers	16.14
Boomstops	18.1.11, 18.2.9, 18.3.6, Appendix U
Brakes	
On-highway type equipment	19.1.1, 19.7.11, 19.7.12, Appendixes U and V
Off-highway crawler-type equipment	19.8.7
Off-highway wheel-type construction machines	19.9, Appendix W
Agricultural and industrial- type equipment	19.10.10
Conveyors and related equipment	18.15
Hoisting equipment	18, Appendix U
Brick and masonry units	11.1.5, 11.6
Burning areas	10.4

C

Cableways, highlines	18.8
Capacitors	14.10.10
Caustics	8.6.3, 17.6.2d
Cement	11.7, 25.2.4
Certification	
Aerial lifts	18.12
Boilers	16.12, 16.14
Brake test record	19.7.12, 19.9.16
Compressors (see Air compressors)	
Diesels, underground	23.6.1
Divers	29.2.2, 29.2.3
Helicopters	18.13.8
Hoist operators	18.1.6
Hoisting equipment	18.1.1
Industrial hygienist	7.1.3
Insulated boom	18.12.13
Major or critical facilities equipment support structures, etc.	2.5, 19.14.11
Power tools	16.7.2
Powderman (blasters)	24.1.3
Rigging hardware	17.1.4
Rollover protective structures	19.8.5, 19.9.5, 19.10.5
Chains	17.1.2, 17.1.3, 17.1.5,

Chain saws	17.2, Appendix L
Chemicals	8.6.5, 16.1.5
	7.6, 7.10.3, 7.11
	8.3
Clearance procedures	14.3, 14.4, 14.7, 15.5
Codes	2.2
Cofferdams	22.4
Cold stress	7.14.2
Combustible liquids	11.12
Combustible materials, storage	11.2.2
Compactors	19.9, Appendix W
Compressed air (see Air compressor)	
Air-line respirators (see Air breathing)	
Cleaning restrictions	16.2.4
Compressed gas cylinders	
General	16.15
LP-gas cylinders	11.14, 23.8.2, 23.8.3
Concrete conveyance systems	25.1.8, Appendix R
Concrete plant	25.1
Confined spaces	7.8
Permit required	7.8.3
Conveyors	18.15, 19.14.11
Cranes (see Hoisting equipment)	
Cutting and welding	8.3.6,
Eye and face protection	8.3
Protective clothing	8.6
Cylinders (see Compressed gas cylinders)	

D

Definitions	1.4, Appendix GG
Demolition	30
Detonating cord	24.13
Diving operations	
Contractor	29.2
Conventional diving	29.2.1
Decompression	29.2.2
Mixed gas	29.2.3
Physical examinations	29.2.2
Scuba	29.2.4
Reclamation	
Scuba	29.3
Surface supplied air	29.3.8
Drilling operation	23.9, 27

Drills	23.9
Eye protection	22.1.6
Excavation operations	22
Safety line	27.4.3
Truck mounted	27.4
Tunnels and shafts	23.2.4, 23.3, 23.9
Drinking water	7.10.2
Dump trucks	19.7.1, 19.7.5, 19.9.13
Dust control	
Drilling	23.5.2
Tunnels and shafts	23.5

E

Earthmoving equipment (also see Equipment, mechanized)	19, Appendixes V and W
Eating facilities	7.10.6
Electrical wiring apparatus	12
Arc welding	16.18, 16.19
Barrier tape	14.9.2
Battery charging	12.8
Bonding	12.5.8, 23.1.5
Clearance program	14.10.5
Code requirements	12.1.1
Double insulation	12.5.2, 16.1.4
Equipment grounds	12.5, 14.6.3, 23.1.5
Ground fault interrupters	12.4
Hazardous locations	12.6
High-voltage equipment	12.1.9
Hot stick	12.11, 14.6.4, 14.9.2
Isolation	12.1.3, 15.2
Lighting strings	12.2.5
Locking and tagging	12.3, 15.2.2
Metal ladders	13.14.2, 14.10.13
Overcurrent protection	12.3.7
Overhead lines, high voltage	12.9
Refueling equipment	11.12.4 66
Safety clearance procedure	14.3 109
Spray painting, electrostatic	11.15.5 70
Stage work in energized facilities	28
Temporary wiring	12.2
Trailing cables	12.10
Transmitter towers	12.11

Tunnels and shafts	23.1.4
Electromagnetic radiation	24.2
Blasting operations	24.2.1
Transmitter towers	12.11, 24.2.2
Elevators	18.9
Emergency equipment	6.2, 19.7.9, 29.2.4i
Eyewash facilities	25.1.10
Flotation devices	8.11
General	6.1
Lifesaving skiffs	8.12
Motor vehicles	19.7.9
Ring buoys	8.11.2
Scuba diving	29.2.4, 29.3.7
Tunnels and shafts	23.2
Emergency plans	6
Tunnels and shafts	23.2
Enclosed spaces (see Confined spaces)	
Energized equipment	14.11.1
Equipment, mechanized (also see Motor vehicles and hoisting equipment)	
A-frame trucks	19.13
Backup alarm	19.7.3, 19.8.8, 22.1.20 Appendixes U, V, and W
Braking systems (see Braking)	
Brake performance test	19.3, Appendixes U, V, W
Certification (see Certification)	
Drill jumbos	23.9.1
Fenders and mudflaps	19.7.7, 19.9.10, Appendixes U, V, and W
Fueling and refueling	11.12.4, 19.4.3
Grounding, electrical	28.3.2
High-voltage lines	12.9.3
Hoisting equipment (see Hoisting equipment)	
Lift trucks	19.12
Maintenance	19.4, Appendixes U, V, and W
Motor vehicles	19.1.1, 19.7, 19.11, Appendix U
Operating rules	19.2
Parking	19.2.3
Pile drivers	18.14
Rock crushers	19.14.8
Rollover protective structures	19.8.2, 19.9.2, 19.10.2,

Seatbelts	Appendix W 19.7.10, 19.8.10, 19.9.8, 19.10.8, Appendixes U, V, W 19.14
Stationary equipment	19.12.4
Steering knobs	18.15.14, 19.14.10
Tagging and locking	23.6, 23.11
Underground operation	19.14.9
Vibrating screens	22
Excavation operations	24.5.10
Blasting	22.4
Cofferdams	23.5, 23.9.1, 24.4.6, 24.7.2, 24.11.4, 27
Drilling	22.1
General requirements	12.9.3
High-voltage lines	22.1
Open excavation	22.1.6
Personal protective equipment	22.3
Structure footings	22.2, Appendix M
Trenching	23
Tunnels and shafts	
Explosive magazines (see Explosives and Blasting operations)	
Explosives (also see Blasting operations)	24, Appendix N
Handling	24.6
Storage	24.5, Appendix N
Transportation	24.3, 24.4
Underground storage	24.5.10
Underground transportation	24.4
Exposure monitoring	7.3
Extension cords	12.2.6
Eye and face protection	8.3
Drilling	22.1.6, 23.1.8
Laser	8.3.8
Selection guide	8.3.4, Appendixes A and B
Water drench	8.7
Welding and cutting	8.3.5, 16.16.5
Eyewash facilities	8.7

F

Fenders	
Mobile equipment	19.7.7, Appendixes U and V
Earthmoving equipment	19.9.10, Appendix W
Fire alarms	10.3.7

Firearms	2.17
Fire extinguishers	10.3.3, Appendixes H and I
Asphalt and tar products	11.13.5
Carbon dioxide systems	10.3.3
Derricks	18.5.5
Flammable liquids	10.3.3, 11.12.2a
Floating cranes and derricks	18.6.3
Heating devices	10.3.3
LP-gas storage	11.14.10
Marine equipment	29.1.6
Material hoists	18.11.16
Material storage	11.1.4
Motor vehicles	19.7.9
Overhead cranes	18.4.12
Powder trucks	24.3.2g
Skid-mounted units	27.3
Tower cranes	18.3.3f
Underground equipment	23.8.9
Welding and cutting	16.16.3
Fire prevention	10.2
Material storage	11.2.3
Smoking	10.2.3
Tunnels and shafts	23.8
Fire protection	10.3
Alarms	10.3.7
Burning areas	10.4
Contractor's plan	10.3.4
Carbon dioxide systems	10.3.3f
Extinguishers (see Fire extinguisher)	
Flammable liquids	10.5.2, 10.5.5
Heating devices	10.5
Inspection schedule	Appendix I
Material storage	11.1.4, 11.2.6
Motor boats	29.1.6
Offsite assistance	10.3.8
Sleeping facilities	7.10.7
Sprinkler protection	10.3.7
Water supply	10.3.9
Welding and cutting	16.16.4
First aid kits	4.2.1
First aid and medical facilities	4
Ambulance	4.3
Eyewash facilities	8.7
General requirements	4.1
Insects, vermin, and snakes	7.14.9

Poisonous plants	7.14.10
Records	4.4
Signs	4.1.3
Training	3.2.2
Fixed ladders	13.14.9, Appendix O
Flagmen, spotters, and signalpersons (also see Signals)	9.6, 9.7
Backing equipment	22.1.20
Helicopter operation	18.13.8o
High-visibility apparel	8.6.2, 9.7.1
Hoisting equipment	9.7
Material hoist	18.11.15
Traffic control	9.2.8
Flammable gases	
Compressed gas cylinders	16.15
Exposure monitoring	7.3, 23.4
Fire prevention	10.2.6
Gas heaters	10.5.3, 10.5.4
Instruction	3.2.1
Liquefied petroleum gas	10.5.4, 11.14, 23.8.3
Tunnels and shafts	23.4, 23.8.3
Welding and cutting	16.17
Flammable liquids	11.12
Classification	Appendix J
Cleaning and degreasing	10.2.5
Disposal	10.2.1
Fire extinguishers	10.3.3
Fire protection	11.12.2, 11.12.3
Handling and dispensing	11.12.3
Housekeeping	11.16.3
Instruction	3.2.1
Paints, varnish, and thinners	11.15
Portable containers	11.12.1
Refueling	11.12.4
Smoking	10.2.3, 11.12.3
Storage	11.12.2
Storage cabinets	11.12.1f
Storage containers	11.12.1e
Underground use	23.8.3
Ventilation	11.12.3
Welding and cutting	16.16.8
Floating cranes	18.6
Floor and wall openings	13.17, 13.18
Food handling	7.10.6
Foot protection	8.6.6

Footings, structure	22.3
Forms, concrete	25.5
Releasing and moving	25.11
Form scaffolds	13.12
Figure four	13.12.4, Appendix K
Metal bracket	13.12.5, Appendix K
Wooden bracket	13.12.6, Appendix K
Foremen	3.2.2, 3.2.3
Fueling, vehicles	11.12.4
Earthmoving equipment	19.2.3
Fire extinguishers	10.3.2
Fuel tank location	19.14.4
LP-gas fuel	11.14.8
Powder trucks	24.3.7

G

Garbage	7.10.4
Gas welding and cutting	16.17
Gates (See also Barricades)	9.2.8
General contractor requirements	2
Glasses, safety (see Eye and face protection)	
Glossary	Appendix GG
Gloves	
Impervious	8.6.3
Rubber	8.6.4, 12.1.6
Grounding, electrical	12.5
Arc welders	16.18.3
Energized facilities	28.3
Equipment grounds	12.5, 14.6.3, 23.1.5
Flammable liquids	11.12.3
Heating devices, temporary	10.5
Personal grounds	14.6, 28.3
Spray painting	11.15.3, 11.15.5
Stage construction in energized facilities	28.3
Tools	16.1.4
Tunnels and shafts	23.1.5
Ground fault interrupters	12.4
Wet locations	12.2.2, 12.3.4, 12.7.1
Ground water	22.1.13, Appendix M
Guarding	
Abrasive wheels	16.3.2
Belts, gears, and shafts	16.1.3, Appendixes R and U

Conveyers	18.15.2
Excavation sites	22.1.18
Machinery	19.14.2
Power saws	16.5
Tools	16.1.3
Tunnels and shafts	23.12.3
Woodworking tools	16.4
Guardrails	13.3
Cofferdams	22.4.2
Conveyers	18.15.2
Design	13.3.1
Drill jumbos	23.9.1
Excavations	22.1.18
Floor and wall openings	13.17, 13.18
Form scaffolds	13.12.3
General requirements	13.1.5, 13.3
Hatchways and chutes	13.17.4
Machinery	19.14.3
Mobile equipment	Appendixes R, U, and W
Roofs and platforms	13.17, 13.19, 13.20
Scaffolds	13.1.5
Stairways	13.15

H

Hand signals	
Helicopter	18.13.8, Appendix F
Hoisting equipment	Appendix F
Road construction (see Haul roads)	
Handtools (see Tools)	
Hardhats	8.2
Haul roads	19.6
High-voltage line crossovers	12.9.2
Signs and controls	9.2.8, Appendix G
Signal and flagpersons	9.7, Appendix G
Hazard communications	7.6
Hazardous materials	7.9
Training	3.2.1
Waste materials	7.9, 11.16.4
Hazardous locations	
Conveyors	18.15.10
Electrical	12.6, 28, 29
Excavation	22.1.12
Floor openings	13.17, 13.19
Hatchways	13.17.4

High voltages	12.1.9
Hoisting equipment	17.3.13
LP-gas	11.14.2
Material storage	11.1.3
Metal ladders	13.14.2
Open floors	13.19
Platforms	13.19
Tools	16.1.7
Wall openings	13.18
Water passage	14.12
Hearing protectors	7.7.5, 8.5
Heating devices, temporary	10.5
Liquid fuel heaters	10.5.2
LP-gas heaters	10.5.4
Natural gas heaters	10.5.3
Open flame	10.5.5
Restricted use	10.5.5
Underground	10.5.5, 23.8.2
Heat stress	7.14.1
Helicopters	18.13.8
Hand signals	Appendix F
High-voltage lines	12.9
Equipment clearance	12.9.2, 12.9.3
Stage construction in energized facilities	28.5.7
Hoisting equipment	18, Appendix U
Aerial lifts	18.12
A-frame trucks	18.13.4, 19.13
Cableways	18.8
Crane-supported personnel platforms	13.21
Crawler, locomotive, truck	18.2, Appendix U
Derricks	18.5
Elevators	18.9
Floating cranes	18.6
General requirements	18.1
Hand powered	16.8, 18.7.9
Hand signals	Appendix F
Helicopter cranes	18.13.8
Material hoists	18.11
Overhead and gantry cranes	18.4
Overhead hoists	18.7
Personnel hoists	18.10
Physical examinations, operators	18.1.6
Scaffold hoists	13.8.1

Shackles and hooks	17.7
Shafts	23.12.4
Signal systems	18.1.17, Appendix F
Specialized hoisting systems	18.13
Testing	18.1.4, Appendix U
Tower cranes	18.3
Underground	23.12.4
Hooks	17.7
Horns, mobile equipment	18.2.7, 19.7.3, 19.9.9, Appendixes U, V, W
Hot line order	14.10.6, 28.2
Housekeeping	11.16
Hydraulic powered tools	16.6
Jacks	16.9
Hydraulic fluids	23.8.6

I

Illumination (see Lighting)	
Impact wrenches	26.8.2
Indoctrination	3.1
Industrial trucks	18.13.3, 19.12
Inert-gas welding	16.19
Insects and vermin	7.14.9
Inspection, safety	2.12
Instruction (also see Training)	3.1, 3.2
Ionizing radiation	7.14.4

J

Job hazard analysis (JHA)	3.5, 7.1.2, 7.3.1, 7.5.1 7.7.4, 11.7.1, 11.13.1, 13.21, 14.7.2, 14.9.2, 19.2.2, 22.1.3, 22.2.5, 29.2.1, App. FF
---------------------------	---

L

Ladders	13.14
Electrical hazard	13.14.2, 14.18.13
Excavation	22.1.4, Appendix M
Floor openings	13.17.3
Trenches	22.1.4
Lasers	7.14.5, 8.3.8

Life jackets	8.11, 8.12, 29.1.5
Lifelines	8.8, 8.8.3, 8.8.5, 8.9
Lift trucks	18.13.3, 19.12
Lighting	7.14.3
Equipment	19.7.2 19.8.8, 19.9.9, 19.10.9, Appendixes U, V, W
Excavation operations	22.1.5
Hazardous locations	12.6
Special programs	7.14.3
Temporary wiring	12.2.5
Tunnels and shafts	23.1.3, 23.2.5
Lime	11.7.3
Linemen's belts	8.9
Liquefied petroleum gas	11.12.4
Heaters	10.5.4
Liquids, flammable and combustible	Appendix J
Underground	23.8.2
Load test (see Testing)	
Loaders, self-propelled	19.9, Appendix W
Lockout/tagout	15
Conveyors	18.15
Electrical	12.3.3
Equipment and machinery	19.14.10
Tags	9.3, Appendix E
Lumber storage	11.5

M

Machinery (stationary)	19.14
Guarding	19.14.2
Tagging and locking	15, 19.14.10, Appendix E
Man haul	19.11
Underground	23.11.3b
Man lift	18.13.1
Marine operations	29.1
Flotation devices	8.11, 29.1.5
Material handling and storage	11
Compressed-gas cylinders	16.15
Disposal	11.6.5
Explosives	24
Flammable liquids	11.12
Indoor storage	11.2
Powerlines	11.1.3
Material hoists	18.11

Shafts	23.12.4
Material safety data sheets	7.6.6, 8.6, 11.2.1, 11.13
Medical facilities	4
Metric equivalents	Appendix HH
Microwaves	7.14.6
Mobile equipment	
Accessories	
Agricultural and industrial	19.10.9
Crawler equipment	19.8.8, Appendix U
Off-highway-type equipment	19.8, 19.9, Appendix W
On-highway-type equipment	19.7, 19.11, Appendix V
Brakes (see Brakes)	
Definition	19.2
Inspection requirements	19.3
General requirements	19.1
Motorcycles, snowmobiles, three wheelers, all-terrain machines	19.1.1
Operational requirements	
General	19.2
Operational tests	19.5
Operator physical qualifications	19.2, 19.11.3, Appendix U
Parking	19.2.3
Performance inspection	
A-frame trucks	19.13.3
Agricultural and Industrial type trucks	19.3
Mobile cranes	18.2.10, 19.3, Appendix U
Off-highway type	19.3, 19.9, Appendix W
On-highway type	19.3, 19.7.12, Appendix V
Unauthorized riding	19.2.8
Unusual equipment configuration	19.2.2
Underground	23.11

N

Nailers, air	16.2.7
Nets, safety	8.10
Steel erection	26.3.3
Noise exposure	7.7
Hearing protection	7.7.5, 8.5
Noise levels underground	7.7.2, 23.7

O

Oil, hydraulic	23.8.6
Opinions, differing	2.4
Overcurrent protection	12.3.7
Overhead lines, high voltage electric	12.9
Overhead protection (also see Mobile equipment)	
Conveyors	18.15.8
Dropping materials	11.16.11
Elevated work areas	13.4.1
Falling objects	13.4.1
Material hoists	18.11.5
Personnel hoists	18.10.9
Pile drivers	18.14.12
Ramps	13.16.3
Scaffolds	13.4.2
Shafts	23.12.4c
Oxygen	
Compressed-gas cylinders	16.15
Deficiency	23.4
Oil-grease	16.15.10

P

Paints, varnish, and thinners	11.15
Personal protective equipment	8
Air-line respirators	8.4.6, Appendix C
Asphalt and tar	11.13.2
Battery charging	12.8.6
Chaps	8.6.5
Clothing	8.6
Concrete finishing	25.1.10
Electrical work	12.1.6
Excavation	22.1.6
Eye and face protection	8.3
Flotation devices	8.11
Foot protection	8.6.6
Gloves	8.6.3, 8.6.4
Hardhats	8.2
Hearing protection	7.7.5, 8.5
Helicopter operations	18.13.8
High-visibility apparel	8.6.2
Insects and vermin	7.14.9
Instruction and training	3.2.1
Lasers	7.14.5

Lifesaving skiffs	8.12
Lifevests	8.11
Linemen's belts	8.9
Maintenance	8.1.2
Nets, safety	8.10
Paints and coatings	11.15.4
Respiratory protection	8.4, Appendix C
Safety belts	8.8
Self-rescuer	8.4.11, 23.2.2, Appendix C
Skin protections	8.7
Tools	16.1.6
Welding leathers	8.6.1
Personnel hoists	18.10
Shafts	23.2.3, 23.12.4
Physical qualifications	2.18
Divers	29.2.2
Examination required	29.2.2
Equipment operators	18.1.6, 27.9
Food handlers	7.10.6a
Hoist operators	18.1.6
Ionizing radiation	7.14.4
Man haul	19.11.3
Piledrivers	18.14
Piling	11.10
Pipe	11.9
Plants and animals	7.14.9, 7.14.10
Platforms	13.19, 13.21
Pneumatic tools	16.2
Poisonous substances (also see Harmful materials)	
Insects and vermin	7.14.9
Instruction	3.2.1
Plants	7.14.10
Snakes	7.14.9
Toxic coatings	8.4.8, 16.16.6
Poles	11.10
Powder-actuated tools	16.7
Power saws	16.5
Power tools (see Tools)	
Pressure Vessels	16
Boilers	16.14
Compressors	16.13
Compressed-gas cylinders	16.15
Protective canopies (also see Equipment, mechanized)	13.21.2d, 18.10.9, 19.7.5

R

Radiation	
Electromagnetic	9.4.3
Instruction, general	9.4, 16.19.3
Ionizing	7.14.4
Materials	7.14.7
Nonionizing (lasers, microwaves)	7.14.5, 7.14.6
Warning signs	9.4
Welding and cutting	16.19.3
Ramps	
Equipment	
Grades	19.6.3
Loading, dumping	19.6.4
Personnel	
General	13.16
Roofing	13.20.4
Records and reports	
Accident	2.13, 2.14
Brakes	
Mobile equipment (see Brakes and equipment, mechanized)	
Hoisting equipment (see Brakes and hoisting equipment)	
Cableway log	18.8.4 162
Diving	29.3.3
Electrical, grounding (assured)	12.5, 14.6, 28.3
Electrical, special work permit	28.2
First aid and medical	4.4
Flammable liquids	11.12.2
Hoisting equipment	18.1.4
Hot line orders	28.2
Noise monitoring	7.7.4
Safety meetings	3.3
Safety program	2.7
Scuba diving	29.2.4
Tunnel ventilation plan	23.3.2, 23.3.3
Underground work	23.1.1
Vibration damage control	24.1.9
Reference material	Appendix II
Reinforcing steel	8.8.4, 25.3
Respiratory protection	8.4, Appendix C
Drilling	27.6.12
Sandblasting (also see Abrasive blasting)	25.4.1

Welding and cutting	16.16
Rigging requirements and tables	17, Appendixes L and S
Riding loads	13.21, 18.1.10, 18.15.13, 23.12.4
Ring buoys	8.11.2, 8.12.2, 29.1.5
Riveting	26.9
Roads	19.6
Rock bolting	22.1.10b, 23.10.4
Rollover protection (see Equipment mechanized)	
Roof openings	13.17
Roofing operations	13.20
Asphalt and tar	11.13
Ropes	
Characteristics, wire rope	17.3, Appendix S
Electrical hazard	17.5.3
Fiber	17.5
General	17.1
Slings	17.4, Appendix L
Synthetic	17.5

S

Safety belts	
Aerial lifts	18.12.6
Construction belts	8.8
Linemen's belts	8.9
Reinforcing steel	8.8.4, 25.3.1
Scaffolds	13.1.4, 13.8.1m, 13.13.6, 13.21.2
Safety equipment, clothing (see Personal protective equipment)	
Safety factor, definition	Appendix GG
Safety fuse	24.12
Safety hooks	17.7.2, 18.1.13
Safety inspections	2.12
Safety line	27.4.3
Safety meetings	
Employees	3.3.2, 3.4
Joint policy	2.10
Preconstruction	2.9
Supervisors	3.3.1, 3.4
Safety of personnel	12.1.3
Safety program	2.7, Appendix BB
Review	2.8

Safety shoes	8.6.6
Sand blasting	
(see Abrasive blasting)	
Sand and gravel	11.11
Sanitation	
Contamination	7.10.5
Potable water	7.10.2
Food handling	7.10.6
Garbage	7.10.4
Sleeping facilities	7.10.7
Toilet facilities	7.10.3
Scaffolding	13, Appendix K
Boatswain's chairs	13.9
Crane supported	13.21
Form	25.11, 25.15
General requirements	13.1
Guardrails (also see Guardrails)	13.3
Housekeeping	11.16
Maintenance	13.5
Mason	13.8.3
Metal	13.10
Outrigger	13.7
Overhead protection	13.4.1, 13.4.2
Planking	13.2
Safety belts	13.1.4, 13.8.1m, 13.20.1,
Slip-forms	25.10.8
Stonesetters	13.8.4
Suspension	13.8
Tube and coupler	13.10.6
Wood pole	13.6
Work platforms, elevated	13.11
Scaling	
Excavation	22.1.10a
Safety belts and lines	8.8
Tunnels and shafts	23.9.1, 23.10.2
Scrapers	19.9
Scuba diving	29.2.4, 29.3.7
Seat belts	
Agricultural and industrial	19.10.8
General	19.2.10
Man-haul and buses	19.11.2
Off-highway-type equipment	19.8.10, 19.9.8
On-highway-type equipment	19.7.10
Shackles and hooks	17.7
Shafts, excavation	23.12

Shoring and cribbing	
Concrete operations	25.6, 25.7, 25.8, 25.9
Excavation	22.1.9, 22.1.11, 22.2.4
Single post shores	25.9
Trenching	22.2, Appendix M
Tube and coupler shores	25.8
Tunnels and shafts	23.12
Signal person (see Flagperson)	
Signals	
Blasting	24.9.3
Cableways	18.8.5
Helicopter cranes	18.13.8o
Hoisting signals	9.5, 18.1.17
Material hoists	18.11.15
Personnel hoists	18.10.21
Traffic control	9.6
Signs	9.2
Battery charging	12.8.1
Blasting area	24.1.10
Blasting signals	24.9.4
Caution	9.2.4
Compressed gases	16.15.2e
Danger	9.2.3
Exit	9.2.5
First aid	4.1.3
Flammable liquids	11.12.1, 11.12.3, 11.12.4
General	9.1, 9.2
Hardhat areas	8.2.3
High voltage	12.1.9, 12.9.2, 14.9.2
Lasers	9.4.1
Powder magazines	24.5.6, 24.5.10
Powder trucks	24.3.2f
Radiation	9.4
Substations	28.4.2
Traffic	9.2.8, 19.6.8
Water, nonpotable	7.10.2
Site clearing	22.1.7
Explosive magazines	24.5.4
Sleeping facilities	7.10.7
Slings	17.1, 17.4, Appendix L
Slip-forms, concrete	25.10
Snakes	7.14.9
Sound levels	7.7.1, 7.7.4, 8.5

Special work permits	28.2
Spray painting	11.15.3
Airless spray guns	16.2.6
Respiratory protection	8.4.5, 8.4.6
Sprinkler protection	10.3.7
Stage construction, energized facilities	28
Stairways	13.15
Railings	13.15.4, 13.15.5, 13.15.6
Stairway openings	13.17.3
Stationary mechanized equipment	19.14
Statutes	2.2
Steel erection	26
Belts and lifelines	8.8, 8.9
Safety nets	8.10, 26.3.3
Storage (see Materials handling and storage)	
Subcontracts	2.1
Substations	28
Surface preparation	25.4
Suspension of operations	23.4.4

T

Taglines	
General	11.1.6, 11.10.2
Helicopter cranes	18.13.8
Hoisting equipment	18.1.20
Steel erection	26.6.6
Temporary wiring	12.2
Testing requirements	18.1.4
Aerial lifts	18.12.4, 18.12.13
A-frame trucks	19.13.3
Blasting	24.8.4
Boilers	16.14
Brakes (see Brakes)	
Compressed-gas cylinders	16.15.1
Cranes	18.2.10
Dust, environmental	7.3, 23.4.2, 23.5.1
Electrical grounding	12.4.2, 12.5.7, 28.3.3
Electrical grounds	12.5.7
Electrical rubber goods	8.6.4
Elevators	18.9.1
Hoisting equipment (see Hoisting equipment)	

Insulated booms	18.12.13
Material hoists	18.11.17
Mobile equipment, operational test	18.13.5, 19.5
Noise levels	7.7.4, 23.7
Personnel hoists	18.10.22
Powder-actuated tools	16.7.9
Rigging hardware	17.1.4
Safety nets	8.10.5
Shaft hoists	23.12.4
Suspension scaffolds	13.8.1q
Toxic and flammable gases	23.4
Unfired pressure vessels	16.12.2
Welding and cutting	16.16.4c
Tire repair	19.4.4
Toilet facilities	7.10.3
Tools	16
Chain saws	8.6.5
Grinding	16.3
Grounding	16.1.4
Guarding	16.1.3
Housekeeping	11.16.6
Hydraulic powered	16.6
Impact wrenches	16.2.1
Nailing and stapling	16.2.7
Nonsparking	16.1.7
Pneumatic	16.2
Powder-actuated	16.7
Powersaws	16.5
Protective equipment	16.1.6
Woodworking	16.4
Tower cranes	18.3
Toxic coatings	16.16.6
Toxic gases, dusts, mists, etc.	7.2
Respiratory protection	8.4
Tunnels and shafts	23.4
Toxic materials (see Toxic gases, dusts, mists, etc.)	
Acids, caustics, and chemicals	3.5, 7.1.2, 7.6.2
Flammable and combustible liquids	11.12
Gases, dusts, mists, etc.	23.4
Protective clothing	8.7
Respiratory protection	8.4
Welding and cutting	16.16
Traffic control	9.2.8, 9.6, 9.7, Appendix G

Training and education	3.2
Aerial lifts	18.12.5
Asphalt and tar	11.13
Confined spaces	7.8.7
First aid/CPR	3.2.2
Flag and signalpersons	9.7.1
Flammable liquids and gases	3.2
General requirements	3.1, 3.2
Harmful materials	3.2.1
Harmful noise	7.7.4
Insects and snakes	7.14.9
Job hazard analysis	3.5
Orientation	3.1
Oxygen deficiency	7.1.5
Plants and animals	7.14.9, 7.14.10
Powder-actuated tools	16.7.2
Radiation exposure	3.2.1, 7.14.4
Respirator	8.4, 8.4.11
Safety belts	8.8.5f
Safety meetings	3.3, 3.4
Signaling (see Signals and flagpersons)	
Supervisors	3.2.3
Toxic gases	3.2.1
Tunnels and shafts	23.2
Transformers	
General	12.1.9
Underground	23.1.4
Trench excavation	22.2
Tunnels and shafts	23
Arc-welders, gasoline	16.18
Blasting	24
Compressed air work	23.14
Diesel engines	23.6
Drilling	23.9.1
Dust control	7.3, 23.5
Electrical	23.1.4
Emergency provisions	23.2
Fire prevention	23.8
Gasoline	16.1.7, 23.8.3
General requirements	23.1
Ground support	23.10
Haulage	23.11
Hoisting equipment	23.12.4
Illumination	23.1.3

LP-gas heaters	10.5.5c, 23.8.2
Noise control	23.7
Self rescuer	8.4.11, 23.2.2, Appendix C
Shaft excavation	23.12
Toxic and flammable gases	23.4
Ventilation	23.3, 23.6.2, Appendix CC

U

Unfired pressure vessels	16.13
--------------------------	-------

V

Variances	2.3
VDT work station	7.13
Vehicles (see Equipment mechanized)	
Ventilation requirements	23.3.1
Asphalt and tar	11.13.3
Battery charging	12.8.2
Flammable liquids	11.12.3b
Paints, varnish, and thinners	11.15.2
Tunnels and shafts	23.3, 23.6.2, Appendix CC
Welding and cutting	7.2, 16.16
Vibration damage control	24.1.9

W

Walkways (also see Ramps)	
Concrete operations	25.3.5
Excavation	22.1.3, 22.1.4
Wall openings	13.18
Washing facilities	7.10.8
Waste disposal	2.15, 7.10.4
Water	
Drinking	7.10.2
Fire protection	10.3.9
Pollution	2.16
Water hazard	
Ground water	22.1.13
Marine operations	29
Protective equipment	8.11, 8.12
Water trucks	19.7, 19.9
Waivers and variances	2.3
Welding and cutting	16.16
Aerial lifts	18.12.11

Arc-welding	16.18
Coatings	16.16.6
Confined spaces	7.8, 16.16.7
Eye and face protection	8.3.5, 8.3.6, 8.3.7, 16.16, Appendixes A and B
Fire protection	16.16.4
Gas welding and cutting	16.17
Inert-gas, metal arc	16.19
Protective clothing	8.6.1, 8.6.6, 16.16.5, 16.19.3
Respiratory protection	8.4, 16.16.7, Appendix C
Scaffolding	13.4.3, 13.21.2d
Ventilation	7.3, 16.16.7
Wire rope	17.1, 17.3, 18.1.12, 18.1.19, 18.8, 18.10.16, 18.13, Appendix S
Wiring, electrical (see Electrical wiring)	
Woodworking tools	16.4

Y

Yo-Yo Operations	18.13.6, 19.2.2
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